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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

601

Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.
June 10, 1914.

A NEW SYSTEM OF COTTON CULTURE AND ITS APPLICATION.[1]

By O. F. Cook,
Bionomist in Charge of Crop Acclimatization and Adaptation Investigations.

INTRODUCTION.

The way to secure an early short-season crop of cotton is to thin the plants later and leave them closer together in the rows than is now customary. Neither of these policies is advisable if used alone, but they give a real advantage when properly combined. Keeping the plants closer together during the early stages of growth restricts the formation of vegetative branches and induces an earlier development of fruiting branches. The new system is based on the principle of controlling the formation of the branches.

CONTROLLING THE FORMATION OF BRANCHES.

The principle of branch control is more likely to be understood if studied as the basis of a new cultural system. Application of the principle will involve a reconsideration of all current opinions regarding such questions as distances between rows, times of planting, methods of cultivation, and the values of different varieties. The spacing of the plants and the stages at which thinning should be done will depend upon the local conditions and the habits of the varieties that are being grown, so that it will not be possible to give specific directions that can be used everywhere without discrimination. In agriculture, as in other arts, every new application of a scientific principle makes an additional demand for intelligence and insight into the problems of production. The contrasts with prevalent theories and practices of cotton culture are so great that careful consideration of the habits of the cotton plant is needed before the full possibilities of cultural improvement can be appreciated.

[1] The descriptive portion of this bulletin (pp. 1-5) is to a large extent reprinted from a paper in Bureau of Plant Industry Circular 115, A New System of Cotton Culture, by O. F. Cook, issued Mar. 1, 1913, which is now out of print.

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The first step toward permanent progress in the new direction is to secure the attention of the intelligent farmer to the principle itself, so that he can begin to observe and experiment on his own account with rows of cotton thinned to different distances and at different stages of growth and thus see for himself the relation of the habits of the plants to the cultural problems. In this case no special equipment of books or instruments is necessary to enable the farmer to study the plant and learn what he needs to know regarding its habits of branching. It is true that these habits are somewhat peculiar from the botanical and biological standpoint, as already pointed out in preceding papers on the subject, but there are no technicalities that interfere in any way with direct observations of the behavior of the plants under the usual farm conditions.

APPLICATION OF IMPROVED METHODS.

Unless the farmer can understand the underlying reasons, he is not likely to adopt a new method or to apply it properly, any more than he can use a new machine to advantage without knowing how it works. This requirement of intelligence may limit the application of an improved method, just as it restricts the use of high-grade machines to those who have the ability to handle them properly and understand their construction. But it is generally agreed that larger rewards for more intelligent and skillful farming are in the interest of agricultural progress, and this is especially true in relation to the cotton industry. To make it seem worth while for intelligent men to remain on the farm would soon counteract the urban tendencies now so much deplored.

That cotton has been considered a "sure crop," even with the most careless farming, is one of the chief reasons for the backward state of the industry. But the need of improvement is now recognized as never before, as a result of the many changes that are being enforced by the invasion of the boll weevil. With the continued advance of the boll weevil the period of sure-crop cotton is drawing to a close, and the rapid expansion of cotton culture in foreign countries shows that a new test of competition in the production of this crop must be met in a few years. In the meantime any improvement that promises increased efficiency of production is worthy of careful consideration.

IMPORTANCE OF STIMULATING EARLINESS.

The chief advantage of the new system of cotton culture, based on the improved method of thinning, is the increased earliness of the crop; or, in other words, the production of more cotton in a shorter period of time. The need of shortening the growing season of cotton has been recognized as the best solution of the problem of securing protection against injury from the boll weevil, but is no less important in regions where the crop is limited by drought or by short seasons, as in the northern districts of the cotton belt.

CONFLICTING OPINIONS ON SPACING COTTON ROWS.

Many intelligent farmers are aware of the fact that rows of cotton accidentally left without thinning are sometimes much more productive than rows that were thinned in the usual manner and have reflected on the possibility of securing larger crops by closer planting, but the underlying biological principle has not been understood. The behavior of cotton in different seasons or under different conditions is so extremely variable that any intelligent farmer might well hesitate to adopt a method of culture suggested by an occasional occurrence like the production of a larger crop on an unthinned row.

In each cotton-growing community there are usually some farmers who believe that cotton should be left closer together in the rows, but the tendency in recent years has been toward wider spacing, owing to a general recognition of the evil effects of having the plants too close together, especially under conditions that favor luxuriant growth. Those who use narrow spacing may boast of phenomenal yields in some seasons, but in other years they appear at a disadvantage with their neighbors. The possibility of making a safe combination of the two conflicting methods seems not to have been suggested. The same conflict is shown in the results of formal experiments to determine the best planting distances as in the popular opinions on the subject. Wide spacing in the rows seemed better in some cases and narrow spacing in others, so that no definite conclusions could be reached.

LARGE PLANTS PRODUCE LATE CROPS.

When the habits of the cotton plant are taken into account it becomes apparent that the theory of wider planting has its limitations, as well as the theory of closer planting. To reduce the number of plants by wider spacing in the rows means that a longer period of time is required to produce a crop, for the reason that large luxuriant plants do not begin to produce flowers and bolls as early as plants of more restricted growth. This is not in accord with what might be considered as the most logical view of the subject. Most people are ready to argue that the plants making the most rapid growth must produce the earliest and largest crop, but the actual behavior of the cotton plant is otherwise. In such cases the biological facts have to be taken into account instead of relying upon the logical deductions.

The biological fact in the present case is that the large luxuriant plants are later in setting and maturing a crop. This is because the young plants in a condition of luxuriant growth develop vegetative limbs at the expense of the lower fruiting branches that are necessary to the production of an early crop. The cotton plant has two different kinds of branches—vegetative branches, sometimes called "wood limbs,' which correspond to the main stalk of the plant, and fruiting branches, which produce the flowers and bolls.

When the habits of branching are understood it becomes apparent that the idea of the largest plants producing the earliest and largest crops does not apply to cotton. Spreading, treelike plants, with numerous vegetative branches, do not represent a favorable condition for earliness or for large yields in short seasons. In the interest of correct thinking on cultural problems the row rather than the individual plant should be considered as the unit. The advantages of the new method are gained by improving the form of the rows. More plants are left in the rows, and yet injurious crowding is avoided. Plants that have numerous vegetative branches are more crowded at 2 or 3 feet than plants with single stalks at 8 or 10 inches. With the vegetative branches controlled, the spacing is no longer a question of feet, but of inches. Rows spaced at 6 inches have usually given better results than those at 12 inches or any greater distance.

EXPOSURE OF FRUITING BRANCHES TO LIGHT.

By avoiding the development of the large wood limbs the rows are kept narrower and more hedgelike, so that the fruiting branches receive sunlight throughout the season. This provides much more favorable conditions for the ripening of the crop. When the vegetative branches are allowed to shut off the light by growing up between the rows, most of the bolls on the lower fruiting branches fail to reach normal maturity. Fields of large luxuriant plants often produce very small crops because only the upright growing ends of the stalks and vegetative branches have access to the light. This undesirable condition is avoided by restricting the development of the vegetative branches in the earlier stages of growth.

Numerous experiments have demonstrated the fact that the usual custom of giving the seedlings full exposure by thinning them to wide distances in the rows is a means of inducing the development of large numbers of vegetative limbs. Too much exposure for the young plants results in too little exposure for the adults by increasing the number of vegetative branches. The effect of exposure at wide distances is influenced, of course, by temperature and fertility of soil, larger numbers of vegetative limbs being produced under conditions that favor the luxuriant growth of the plants. But it does not appear that the production of vegetative branches is desirable under any condition. The improved method of thinning restricts the development of vegetative limbs or avoids their formation altogether. This permits a better development of the fruiting branches of the lower part of the main stalk. The plants are induced to fruit earlier and the crop is made larger because more of the early plants can be grown on the same area.

COMPETITION BETWEEN TWO KINDS OF BRANCHES.

The reason this possibility of cultural improvement has not received adequate consideration in the past is doubtless to be found in the fact that the distinctness of the two kinds of branches has not been recognized, nor the relation of this specialization to the method of thinning. When the plants are thinned too young, so as to stand more than 6 inches apart, they put forth a full quota of vegetative limbs, and the subsequent competition and crowding of these limbs with each other and with the main stalks interfere with the development of normal fruiting branches. As it is the low joints of the stalk that produce the undersirablo vegetative branches, the plants must be allowed to grow beyond these joints before thinning. Exposure of the stalk to the light in the early stages of growth is one of the factors that lead to the putting forth of the vegetative branches.

EFFECTS OF EXTERNAL CONDITIONS ON BRANCH FORMATION.

The number of vegetative branches is also influenced by temperature and soil conditions. If the weather remains cool, or if the soil is very dry, not many vegetative branches will develop, even when the young plants are widely separated. But if the conditions favor a luxuriant development of the young plants, early thinning will result in the development of a large number of vegetative branches, and the subsequent crowding will be great. Even in the absence of any disease or insect pests the crop may be ruined by crowding alone. Thus, the extent of the injury from crowding depends very largely on the conditions that obtain during the early development of the plant when the formation of vegetative branches is determined.

Until the habits of the branching are taken into account, it seems impossible to explain the widely different results that are often secured when the same experiments are repeated in different places or in the same place in different seasons. From the present point of view, it is easy to understand that merely statistical experiments made without recognizing the effects of different methods of thinning upon the formation of branches would be likely to reach only ambiguous results. The development of the branches, though very easily influenced in the early stages of growth, completely alters the subsequent behavior of the plants. The effect seems out of all proportion to the exciting cause, like touching off a charge of powder or pulling the trigger of a gun.

Wider spacing appears as the only alternative as long as the young plants are led to put forth a full equipment of vegetative limbs by too much exposure in the early stages of growth. That the development of these limbs may be avoided by a later and more gradual thinning of the young plants must be recognized before it is possible to understand the advantages of the new system. When good crops are produced on rows that are not thinned at all, it is because the plants remain so close together that no vegetative limbs are developed. The new system provides for a more regular and effective application of the same principle of suppression of vegetative branches.

WHY FARMERS ARE ADVISED TO TRY THINNING EXPERIMENTS.

Farmers are advised to experiment with the new system in order to learn how to use it. The experiments that have been made by the Department of Agriculture leave no doubt of the practical advantages that are to be gained by suppressing the vegetative branches, but it is not expected that the farmer will secure a practical familiarity with the system merely by reading about the experiments that others have made.

How long the thinning should be delayed to suppress the vegetative branches and how close the plants should be left in the rows are questions that the skillful farmer should learn to determine for himself, since the actual conditions must be taken into account to secure the best results. If the farmer does not look into the subject far enough to grasp the underlying principle, he is not likely to be able to appreciate the new method or to use it to the best advantage. Hence no explicit directions were issued when the new system was announced, but farmers were advised to study the matter for themselves and to make experiments with a few rows of cotton in order to see that they really understand the principle and to make sure that they are able to secure an advantage from it before attempting to apply it to their whole crop.

The two features of the new system—deferred thinning and closer spacing—must be properly combined in order to insure a favorable result. Most farmers believe that either of these changes will injure the crop, and the danger is that they will try one change without the other instead of making a complete break with previous theories and methods. Until the principle of branch control is understood it is difficult to believe that two apparently injurious changes can have a beneficial result. Attention must be called to the peculiar structure and habits of the cotton plant, in order to place in the hands of the farmer this new power of controlling the development of his crop. The introduction and general utilization of the new system is hardly to be expected without a campaign of education. Not many farmers will be able to believe the new doctrine, and still fewer will apply it successfully, merely from reading or hearing about it. They must be induced to try the experiment for themselves, and to encourage this tendency nothing is so good as an example. Hence, it is believed that the following letter from one of the cooperators of the Department of Agriculture in South Carolina will be of interest:

EASLEY, S. C., *February 14, 1914.*

Mr. O. F. COOK, *Washington, D. C.*

DEAR MR. COOK: Perhaps you may remember that in the very late patch of Columbia one row was left thick. I carefully gathered and weighed that row, as I also did the row on either side. The result was as follows:

Number and length of row.	Number of plants.	First picking.	Second picking.	Total yield.	Yield per acre.	Proportion of lint.[1]	Length of staple.[1]
		Pounds.	*Pounds.*	*Pounds.*	*Pounds*	*Per cent.*	*Inches.*
1. 335 feet	118	16	9	25	655	30.0	$1\frac{1}{16}$
2. 352 feet	294	28	$13\frac{1}{2}$	$41\frac{1}{2}$	1,020.9	31.0	$1\frac{1}{8}$
3. 359 feet	119	20	$12\frac{5}{8}$	$32\frac{5}{8}$	793	29.5	$1\frac{1}{16}$

[1] These figures were added at Washington, on the basis of the samples furnished by Mr. Carpenter. It will be observed that the rows reported in Mr. Carpenter's letter are of unequal length, which makes it somewhat difficult to compare the results. On a basis of computation for rows of a uniform length of 300 feet, the yields of the three rows would have been 22.37 pounds, 35.31 pounds, and 27.20 pounds, respectively.

About one-third were cut off by frost.

The increased yield of the third row over the first row was probably due in a large measure to the fact that this row was within 10 feet of the terrace and the soil is therefore deeper. Recognizing this inequality caused me to take the row on either side for comparison with our crowded row.

However, I would not trespass on your time with these results—for they have already been established by your Norfolk experiment—had I not wished you to assist me one step more. I especially desire to know if there is any effect on the lint, and, if so, in what way. Possibly you may have made this investigation. If so, I would appreciate receiving the bulletin containing the results.

But as you may not have made the inquiry, I have mailed to-day to Mr. Anders a sample of seed cotton from each of these three rows, hoping that with the appliances that doubtless your office has he may be able to throw some light on this, to the producer, most interesting question.

Yours truly, C. H. CARPENTER.

RESULTS OF OTHER EXPERIMENTS.

The results secured by Mr. Carpenter are, as he recognized, in substantial accord with those obtained in experiments with the new method of thinning at Norfolk, Va., in the season of 1912, as published in Circular No. 115 of the Bureau of Plant Industry. In Mr. Carpenter's experiment the close-spaced row exceeded one of the open rows by 57.8 per cent and the other by 29.8 per cent. At Norfolk in 1912 the average gain of 7 close rows compared with 7 open rows was 53 per cent. In a similar experiment in 1913, in which 37 rows were compared with 37 open rows, the average gain of the close rows over the open rows was 35 per cent in the first picking and 26 per cent in the total crop. Figure 1 affords a graphic illustration of the behavior of the close and open rows of the experiment of 1912 and an equal number of rows of the experiment of 1913. These experiments were made with the Durango cotton, instead of with the Columbia, and the plants were left much closer in the rows than in Mr. Carpenter's experiment.

Of course, it is not to be expected that all experiments will show such striking advantages for the close-spaced rows. The desirability of suppressing the vegetative branches was first recognized in experiments with Egyptian cotton in Arizona and southern California, though the actual differences in yield have been less striking under the conditions in the Southwest, because the seasons are longer. With sufficiently long seasons and ideal conditions in other respects, the open rows might equal the close rows, but most seasons are not ideal, and it is usually a practical advantage to secure an early crop.

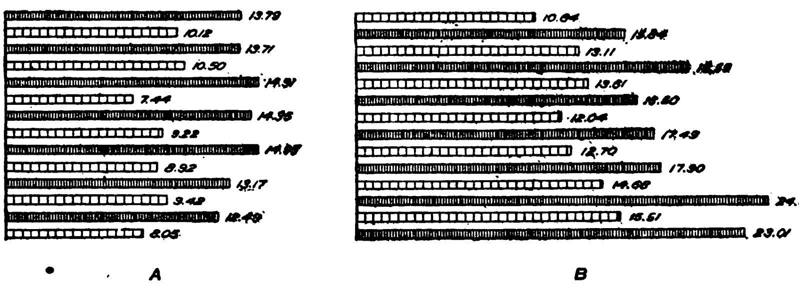

FIG. 1.—Diagrams showing comparative yields of close-spaced and open-spaced rows of Durango cotton, each row representing 0.01 of an acre. *A*, Grown at the Virginia Truck Experiment Station at Diamond Springs, Va., in 1912; *B*, grown at Deep Creek, Va., in 1913.

Under weevil conditions earliness is recognized as a matter of primary importance, for insects are often able to prevent the setting of any bolls in the latter part of the season.

NO ADVERSE EFFECT ON THE LINT.

In answering Mr. Carpenter's question regarding the effect of closer spacing on the length of the lint, the samples received by Mr. Anders were carefully compared by combing out the lint of individual seeds and mounting them in parallel series and the ginned fiber was submitted to an expert classer, Mr. D. E. Earle. In neither of these examinations was it possible to detect any indication of an adverse effect due to the closer spacing. The position of the rows on the terrace seemed to have had more influence than the distance between the plants in the rows. The lint of the outside row was slightly longer than that of the inside row, with the close-spaced row strictly intermediate and not at all inferior in strength or drag to the others, but, if anything, slightly better, in the opinion of Mr. Earle.

It would not appear unreasonable to suppose that there might be at least a very slight shortening of the lint as a result of closer planting, for it has been observed in some experiments that the bolls of the close-spaced rows averaged somewhat smaller and that a larger percentage of the bolls had only four locks. But it seems likely that any slight difference that may exist in the length of the lint will be more than made good by the greater uniformity. Large overgrown plants often yield very irregular lint, because they are much more likely to be checked severely by unfavorable conditions. It has been noticed in some of the experiments that when the large plants in the open rows become wilted in the middle of the day, the smaller plants in the close rows remain fresh. An effect of this kind may be responsible for the different lint percentages found in the samples sent by Mr. Carpenter. The samples were divided, so that two independent determinations of the percentage could be made in each case, but the results were the same.

SUGGESTIONS FOR FURTHER EXPERIMENTS.

As Mr. Carpenter's letter shows, the experiment was a very simple one that any farmer could make for himself if sufficiently interested in learning how to use the new system. More accurate comparisons can be made, of course, if the new system is applied to several rows or small blocks alternating with others thinned in the usual way, but even a single row may serve to demonstrate the principal effects of the improved method, the suppression of the vegetative branches and the increased earliness of the crop. No special precautions are necessary in the planting or cultivation of the rows that are to be thinned in the new way, except to keep them from being chopped out too early with the rest of the field. If general advice were to be given, 8 or 9 inches might be suggested as a safe distance, but under some conditions closer spacing may be better. In experiments with Egyptian cotton in Arizona, rows spaced to 3 inches have given the highest yield at the first picking.

In many cases all that is necessary is to leave the experimental rows without chopping until the plants are 8 or 10 inches high and then thin out to 8 or 10 inches apart in the rows. A still safer course is to thin to 2 or 3 inches when the plants are 8 or 10 inches high and to make the final thinning when the plants are 12 to 15 inches high. For the final thinning, any distance from 6 to 12 inches in the row is likely to give better results than a greater distance, if the thinning is done at the right time.

It will be found interesting to vary the time of thinning as well as the spacing in the row. Under some conditions it may be desirable to leave the plants till they are 12 or even 15 inches tall before thinning and then pull out only a few of them. One advantage of leaving several rows to be thinned by the new method is that different distances can be tried, so that the farmer who studies his experiment can form his own judgment regarding the best distance for the variety and the local conditions. Thinning too early allows too many of the vegetative branches to start, so that the object of suppressing these branches is only partially accomplished. In cool seasons or under conditions that do not favor the rapid, luxuriant growth of the young plants somewhat earlier thinning may be advisable, for under such conditions there is less danger of producing vegetative branches. With this danger avoided it is desirable to allow the fruiting branches to develop as rapidly as possible. Some varieties have less tendency to produce vegetative branches, and it may be that such varieties can be thinned somewhat earlier without losing the advantage of suppressing the vegetative branches. But there is seldom, if ever, any advantage in having the young plants stand wide apart. Usually they grow much more rapidly when allowed to remain close together during the seedling stage.

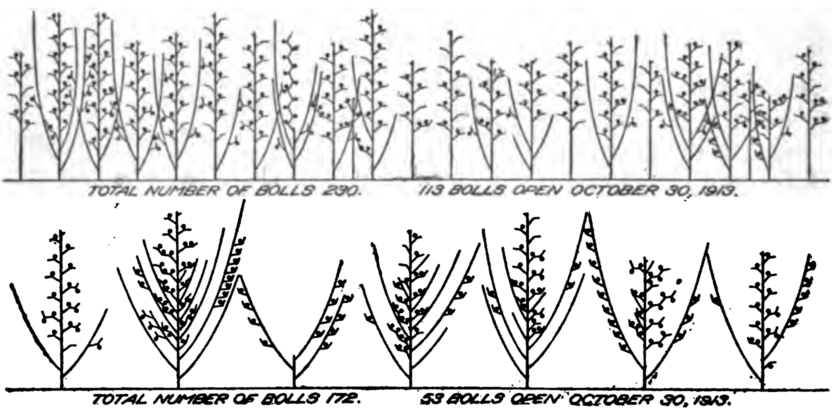

FIG. 2.—Diagrams of plants growing in 15 feet of adjacent open-spaced and close-spaced rows of Durango cotton at Deep Creek, near Norfolk, Va. These are portions of two of the rows represented in the diagram shown at *B* in figure 1.

If the stand is very thick, so that the seedlings stand on the average less than 1 or 2 inches apart in the row, a slightly early thinning or chopping may be advisable, to open up the thickest places where the young plants may become too spindling, but not enough plants should be taken out to break the continuous hedge formation of the row. The exposure of the stalks of the young plants to the sunlight seems to be one of the exciting causes that induce the development of vegetative branches. Young plants that stand 6 inches or more from their neighbors are likely to put forth full sets of vegetative branches if other conditions are favorable for luxuriant growth. Hence, the plants must be kept less than 6 inches apart in the early stages if suppression of the branches is to be insured. The nature of the effect produced by keeping the plants closer together in the rows may be understood by reference to figure 2, which shows a diagram prepared by Mr. G. S. Meloy from actual counts of bolls and measurements of the main stalks and vegetative branches of plants growing in adjacent rows in an experiment with Durango cotton near Norfolk, Va., in the season of 1913. The distances between the plants, the height of the main stalks, and the length of the vegetative branches are drawn to the same scale. It will be seen that development of the vegetative branches has been restricted greatly in the close-spaced row and that most of the bolls are produced on fruiting branches of the main stalks instead of on the vegetative branches. On October 30 there were 53 open bolls on the open-spaced plants as compared with 113 open bolls in the same distance in the adjacent close-spaced row.

Where the stand is poor, so that the average distance between the plants is 3 or 4 inches and the conditions do not favor luxuriant growth, some of the rows may be left without any thinning, and these are likely to be earlier and more productive than those that are thinned. This will afford still more striking evidence of the fact that the present method of thinning early to wide distances often reduces the yield. When thinning is deferred, the farmer can handle his crop in closer accord with the actual conditions of growth.

INCIDENTAL ADVANTAGES OF CLOSER SPACING.

Leaving the plants close together in the earlier stages is distinctly beneficial on account of the mutual protection against exposure to heat and cold, and especially against the wind, which often kills young seedlings that have been thinned too early. The wind may be directly injurious by breaking, beating, or shriveling the plants, and indirectly by blowing sand against the young stalks until they are wounded or actually cut off.

Exposure is also responsible for extensive injuries to young seedlings by the leaf-cut disorder. This is often confused with the leaf curl caused by plant lice, but in reality is entirely distinct. Leaving the young plants closer together is a means of reducing leaf-cut injury and of shortening the period of susceptibility.[1]

The exposure of the seedlings to such dangers is increased when cotton is planted very early. Many farmers prefer to plant early, especially in Texas and other Southwestern States, because they have noticed that late-planted cotton "grows more weed"; that is, the plants are too luxuriant and have too many vegetative branches. But with a practical method of controlling the formation of the branches there is less reason for taking the other risks of very early planting.

Another advantage of later thinning is that the weak and deformed or otherwise abnormal plants are easily recognized and pulled out, leaving the best individuals to produce the crop. Preserving the continuous hedge formation of the rows also keeps the weeds from springing up between the plants and close along the rows, so that not so much hand labor is required in weeding and hoeing. The

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[1] Cook, O. F. Leaf cut, or tomosis, a disorder of cotton seedlings. U. S. Department of Agriculture, Bureau of Plant Industry, Circular 120, 1913.

more upright form of the plants leaves more open space between the rows and permits horse cultivation to be continued later in the season. The foliage is not so close to the ground, and there are more chances that fallen buds or "squares" containing weevil larvæ will be reached and dried out by the sun than when the plants are allowed to send out long branches from the base of the stalk. If open-spaced plants are at all luxuriant, the lower branches are likely to become prostrate, so that the ground is completely covered.

Thus, it becomes apparent that many cultural operations and factors of production are likely to be affected by the application of the principle of branch control. This is the reason why it seemed best to announce the application of the principle of controlling the formation of the branches as a new system of cotton culture rather than as an improved method of thinning. The suppression of the vegetative branches by later and more gradual thinning is a radical departure from the present system and opens the way to many other improvements of cultural methods.

CONCLUSIONS.

The new system of cotton culture is based on the application of a principle not hitherto recognized in cultural experiments—the control of the vegetative branches by improved methods of thinning. The formation of vegetative branches can be controlled by leaving the plants closer together during the early stages, until the stalks have grown beyond the stage where vegetative branches are produced.

The essential feature of the new system is later or more gradual thinning. This makes it possible to leave more plants in the rows than is now customary, and yet injurious crowding is avoided through suppression of the vegetative branches.

The control or suppression of the vegetative branches also permits an earlier development of fruiting branches and leads to the production of an earlier crop. In regions where the period of crop production is limited, either by short seasons or by the presence of the boll weevil, increased earliness is a means of securing larger yields.

When the incidental advantages are understood and added to the chief consideration of increased earliness and larger yields in short seasons, the prospect of usefulness for the new system appears very large. It is especially adapted to weevil conditions, for there the problem of short-season production is most acute. No other way has been suggested whereby it is possible for the farmer to gain such direct control of the behavior of his crop. The danger of weevil injury is greatest under conditions that favor the luxuriant growth of the young plants and induce the formation of large numbers of vegetative branches, and it is under such conditions that the control of the formation of branches becomes most effective as a method of weevil resistance.

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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

602

Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.
August 21, 1914.

PRODUCTION OF CLEAN MILK.

Prepared in the Dairy Division.

Every owner of a dairy herd should consider it his duty to himself and to the community to keep only healthy cows, supply them

FIG. 1.—A clean milker in a clean stable at milking time. Note the clean suit, sanitary milking stool, small-top pail, cow with clean flanks and udder, and sanitary stable construction. Under these conditions it is an easy matter to produce clean milk.

NOTE.—This bulletin is intended to be of especial value to all persons engaged in the production of milk, and also to consumers who are interested in procuring clean, safe milk.

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with wholesome feed and keep them in clean, comfortable quarters. He will also find it the most profitable.

The milkers and all who handle the milk should realize that they have in their charge a food which is easily contaminated; and should therefore take all reasonable precautions to prevent the milk from becoming a source of danger to themselves and others.

The consumer should understand that clean, safe milk is worth more and costs more to produce than milk which contains dirt and disease germs and should therefore be willing to pay more for it than for dirty milk, which is dear at any price.

DEFINITION OF CLEAN MILK.

While a rigid application of the definition of the word "clean" would exclude milk which contains foreign matter or any bacteria whatever, for ordinary purposes we may understand clean milk to be milk from healthy cows that is free from dirt and contains only a small number of bacteria, none of which are of a disease-producing nature.

By exercising proper care the number of bacteria which get into the milk during the process of milking is small, but these will increase rapidly if the milk is not kept cool until used.

If fresh milk contains a large number of bacteria, it indicates that the milk has become contaminated during the process of milking, although in some cases many of the bacteria may come from an infected udder.

If milk contains large numbers of bacteria when it reaches the consumer either it is not fresh, has come from a diseased cow or has otherwise been contaminated, or it has not been kept cool. Although such milk may contain no visible dirt, it is not bacteriologically clean and should not be sold as clean milk.

If milk contains large numbers of blood corpuscles or pus cells, it is an indication that the cow from which it was drawn is diseased.

Milk from a diseased cow, from one about to calve, or from one that has very recently calved possesses abnormal qualities, and though it may not always be dangerous to use, it can not be considered as clean milk and should not be used as such.

BACTERIA IN MILK.

All milk unless collected under very exceptional circumstances contains some bacteria. (Bacteria are single-celled plants so small that they can not be seen with the naked eye.) Milk furnishes all the food material and other necessary conditions for bacterial growth. The bacteria commonly found in milk grow most rapidly at temperatures between 80° and 100° F. Each bacterium at maturity divides into two and under favorable conditions the two new individuals may become full grown and repeat the process of division in 20 or 30 minutes. At a temperature below the most favorable point the growth of bacteria is retarded, but continues slowly. Growth at 70° is rapid; at 50° it is much retarded, and at 40° or below it is very slow. Some bacteria continue to grow, however, even at the freezing point.

The rapidity with which bacteria multiply in milk, at different temperatures, is shown in Table I.

TABLE I.—*Rapidity with which bacteria multiply in milk.*

Relative growth of bacteria when held at different temperatures.					
Temperature of milk.	Number per cubic centimeter at beginning.	Number at end of 6 hours.	Number at end of 12 hours.	Number at end of 24 hours.	Number at end of 40 hours.
° *F.*					
50	10	12	15	41	62
68	10	17	242	61,280	3,574,990

If the milk had contained 1,000 bacteria per cubic centimeter at the beginning, the part held at 50° F. would have contained 4,100 bacteria at the end of 24 hours while that held at 68° F. would have contained 6,128,000. The effect of temperature upon the growth of bacteria is shown graphically in figure 2.

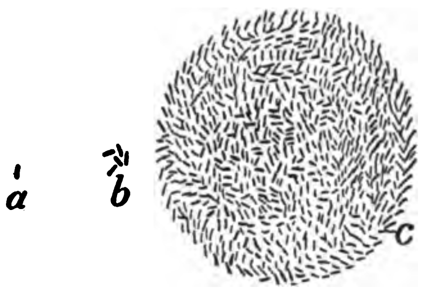

FIG. 2.—This diagram (after Conn) shows the rapidity with which bacteria multiply in milk not properly cooled. A single bacterium (*a*) in 24 hours multiplied to 5 (*b*) in milk kept at 50° F.; (*c*) represents the number that develop from a single bacterium kept 24 hours in milk at 70° F.

Many of the bacteria commonly found in milk produce no apparent change in the milk. Others may change the flavor without changing the appearance, while some of the most common types of bacteria cause marked changes in both appearance and flavor. In this class are included the bacteria which sour the milk by converting the sugar into lactic acid and those which form a sweet curd. Another type destroys the casein and albumen in the milk and causes putrefaction and bad odors.

The number of bacteria in milk depends, first, on the number of bacteria in the udder; second, on the amount of contamination from outside sources; and, third, on the rapidity of the bacterial growth. The rate of growth depends on the temperature at which the milk is held.

SOURCES OF MILK CONTAMINATION.

Bacteria find their way into the milk from various sources. Some may come from the udder itself, where they grow in the milk cisterns and ducts. The greater number, however, come from the dust of the air, the dirt from the udder and flanks, from the milker, and from unclean utensils. Disease-producing bacteria may get into the milk from cows having such diseases as tuberculosis, or from people who handle the milk, who may themselves have contagious diseases or who have been taking care of patients afflicted with such diseases as typhoid fever, diphtheria, and septic sore throat.

The consumer is sometimes responsible for the contamination of the milk. Milk bottles should not be taken into a sick room, because infectious diseases can be spread by carrying infected bottles back to the dairy farm. If bottles are left where there are contagious diseases, they should not be collected by the milkman until they have been properly disinfected by the board of health. In the case of typhoid fever or other serious diseases which may be carried in the milk, it is better for the consumer to put out a covered dish for the milk or have it delivered to some member of the household. Until official permission has been granted, no milk bottles should be removed from a home in which there is or has recently been a case of communicable disease. The consumer should not use milk bottles for holding vinegar, kerosene, or liquids other than milk.

IMPORTANCE OF CLEAN MILK TO THE CONSUMER.

The consumer is interested in clean milk primarily because no one cares to use a food which is not produced and handled under sanitary conditions. There is a more direct interest, however, because of the danger of contracting disease which may be communicated by this means. Serious epidemics of typhoid fever, septic sore throat, and other diseases have been disseminated through the milk supply. The weight of scientific evidence at the present time leads to the conclusion that tuberculosis may be transmitted from animals to human beings, particularly children, who consume raw milk containing tubercle bacilli.

Cleanliness is not an absolute safeguard against disease, but it is the greatest factor in preventing contamination. From the health standpoint there is great danger not only from the specific disease-producing bacteria previously mentioned, but from milk that contains large numbers of miscellaneous bacteria which may cause serious digestive troubles, especially in infants and invalids whose diet consists chiefly of milk. There is also the minor consideration of the loss to the consumer from milk souring or otherwise spoiling before it can be used. The cleaner the milk, the longer it will keep good and sweet.

IMPORTANCE OF CLEAN MILK TO THE PRODUCER.

Clean milk not only benefits the consumer, but the milk producer who will consider this subject from an unbiased standpoint will find many ways in which he himself is benefited by producing clean milk. There are a number of items in this connection which, when considered alone, may seem unimportant, yet collectively they are of great importance. Moreover, they are not only of immediate value, but have a cumulative value reaching far into the future. Tuberculin testing, for example, is not only a safeguard to the purity of the milk supply for the consumer, but is a means of assisting the producer to protect his herd against future ravages of tuberculosis.

Most producers of market milk have experienced the chagrin of having a shipment of milk refused or returned because it reached the market sour, tainted, or otherwise in poor condition. Although such milk may be used for feeding pigs it usually means a complete loss to the producer, as it costs too much to transport it back to the farm and because, depending on the market as an outlet for his milk, he has no means for utilizing small amounts at uncertain intervals. Another important consideration is the unpleasant effect upon the purchaser. Delivering sour or tainted milk usually results in losing the confidence of the dealer; or if it is delivered direct to the consumer, it means the loss of good customers. A reputation for clean milk means fewer complaints, a better class of patrons, and a steady market for the product of the dairy.

Safeguarding the purity of the milk is a protection to health on the farm in several ways; first, the health of the farmer's family, who use a portion of the milk themselves; second, the health of the calves, which live largely on milk. Healthy cows to breed from and pure milk to feed upon are two important factors in rearing thrifty calves and in the development and maintenance of a healthy and profitable herd. Aside from these immediate and definite benefits there is another consideration, not immediately measurable but of vast influence, namely, the moral influence, for no one can learn to produce good and clean milk without learning good methods of care and management of the herd, and the study of these things leads to greater care and intelligence in the economic features of the business.

THE COST OF MILK.

There has been too much indifference on the part of consumers with respect to the cleanliness of milk; too many of them desire to buy milk at a low price and do not give any consideration to quality. Dirty milk may prove expensive as a gift, while clean milk may be economical even at a high price; the cheapest article is often the most expensive. A higher price for clean milk may be a cheap insurance against some form of sickness. It is gratifying to note, however, an increasing demand for good, clean milk. This demand has resulted in more stringent regulations concerning the sanitary conditions associated with the milk supply. Compliance with these sanitary rules requires additional care, attention, and extra expense on the part of the producer of the milk, and while this expense may not be large, it is only fair that the consumer should pay his share of the cost of improving the quality of the milk. The consumer can not expect to purchase a clean, safe milk at the same price as a dirty milk which endangers the health of his family.

A more serious consideration is the marked increase in the cost of production which has resulted in recent years from feed and labor problems. This increase is in keeping with the increase in the cost of almost every commodity, and the consumer must expect to pay his portion of any legitimate increase in the cost of production occasioned by these conditions.

On the other hand there is need of more attention to better management on the average farm devoted to the production of milk. The amount of milk produced per cow is frequently so low as to reflect seriously upon the business ability of the owner. A producer who makes no systematic effort to lower the cost of production by increasing the average production of milk per cow is entitled to little sympathy if he finds the business unprofitable. The profits yielded by a good cow often go to offset losses caused by poor cows in the same stable. The keeping of records of production of each individual in the herd, the elimination of unprofitable cows, the improvement of the herd through selection of the best producers and breeding them to a bull of dairy merit, and the selection of the best heifers from such breeding are necessary to put milk production on a sound basis. Unless the producer does these things he disregards the fundamental principles of business economy, and it is unreasonable for such a man to expect the consumer to pay him a profit on business practices which represent such economic waste. There is no good excuse for slack business methods on the dairy farm. Directions for keeping records of milk yields and cost of production are furnished by every State agricultural college and by the United States Department of Agriculture.

HOW TO PRODUCE CLEAN MILK.

THE COWS AND THEIR CARE.

To have healthy cows is one of the first essentials of the production of clean milk. If the cows are diseased their milk is apt to contain disease-producing bacteria, or be otherwise abnormal. Such milk is not clean nor safe as an article of food even though there is no visible dirt in it.

The cows should be tested for tuberculosis by a capable veterinarian at least once a year, and if diseased animals are found the herd should be tested twice a year. All cows which react, showing that they are infected with the disease, should be removed from the herd and the stable and premises thoroughly disinfected.[1] No additions should be made to the herd without subjecting all animals purchased to the tuberculin test before they are brought to the farm. They should then be kept separate from the other animals for at least 60 days and retested. Without the use of tuberculin the cattle owner is confronted with serious and continuous losses; with its use the disease can be eradicated from the herd and the danger of its spread to man from this source removed.

Special attention should be given to the condition of the udder, and any milk which appears slimy, ropy, watery, or otherwise abnormal, should not be used as food. As a rule milk should not be used within 15 days before calving or during the first 5 days after calving. It is well not to use milk from cows which have been given powerful drugs, for they may pass through the tissues of the mammary gland and into the milk.

The external condition of the cow is a most important factor in the production of clean milk. One of the greatest sources of milk contamination is the dirt on the outside of the animal's body. It is therefore essential that extra care be given to keeping the cow free from accumulations of mud and manure. Grooming is usually dispensed with as it costs money, yet there is far more reason for the daily grooming of an animal that produces human food than of a horse which hauls a manure spreader or a garbage wagon. Custom, however, demands that the horse be kept clean and this custom must be extended to include cows on farms where clean milk is produced. Cows on pasture usually keep cleaner than when in the barn, but though they appear clean they may be very dusty and should be brushed before each milking period. When kept in stables they require a thorough cleaning at least once every day. It is well to clip the long hairs from the udder, flanks, and tail, in order that dirt may not cling to them. It is desirable that the bedding be clean, dry, and used in sufficient quantities to promote the comfort of the animal, especially where the floor is of concrete.

The cow should not be groomed, bedded, or fed immediately before milking, as these operations fill the stable air with dust and bacteria. Frequent attention to the distribution of bedding is just as important as to supply a large amount of it. Often a tour through the stables the last thing at night and a few minutes' attention to the distribution of the bedding at that time will save half an hour's work of cleaning

[1] Directions for disinfecting stables are given in Farmers' Bulletin No. 480.

the cows in the morning. If the manure is daily removed a considerable distance from the stable, bad odors from it will be kept from tainting the milk, and it will diminish the danger of contamination from filth-laden flies. The fly nuisance is caused by accumulations of manure in which the flies breed, and if conditions are favorable for daily removal of manure to the fields, this should be done. Flies carry bacteria and filth, and earnest efforts should be made to keep the stable free from them. If the stable and its surroundings are clean, free from accumulations of manure and other materials which attract flies, the stable can be kept fairly free of them by the use of fly poison and traps. Good forms of fly traps are described in Farmers' Bulletins 532 and 540. In addition to removing the accumulated manure from the gutter every day, the soiled bedding from under the cow should be raked back into the gutter and replaced with clean bedding. No animals other than cows should be allowed in the stable. The open-shed system of keeping cows is advocated by many dairymen and has some advantages, but it is essential that the shed be kept dry and be open on the south side. This method is being thoroughly tested at the dairy farm of the Bureau of Animal Industry at Beltsville, Md.

The feed for cows should be palatable and nutritious. Moldy and decayed feed and such feeds as may injuriously affect the cow's health or the character of the milk should be carefully avoided. The odor and flavor of milk are very readily affected by rape, cabbage, turnips, and other feeds having strong odors, and where these are used they should be given after milking, in which case there is little danger of contaminating the milk. Where pastures are overrun with garlic or wild onion the cows should be removed from the pasture several hours before milking.

When silage first came into use as a feed for dairy cows there were many objections to it on the ground that it unfavorably affected the flavor of the milk, but these complaints are now less common, as the bad flavors have been found to be due to a poor quality of silage, improper feeding, or because silage odors were absorbed from the stable air. Good silage fed in reasonable amounts after milking will not injure the health of the cow nor impair the quality of the milk. It must be fed after milking and all uneaten silage removed so that the silage odors will disappear from the air before the next milking period. Many health authorities forbid the feeding of wet brewers' or distillers' grains to cows because the wet grains ferment rapidly and produce strong odors which are absorbed by the milk, and under ordinary conditions the stable and cows become so filthy that the production of clean milk is impossible.

Owing to the dust and odors which arise from the feeding of hay, grain, and silage, it is best, from a sanitary standpoint, to feed after milking rather than before. A liberal supply of salt should be provided in a place where the cows can have ready access to it. It is of prime importance that the cows have an abundance of fresh, pure water. Cows which produce 25 pounds of milk a day require 75 pounds or more of water daily, and instances are on record in which heavy milkers have consumed more than 300 pounds of water a day. This large quantity of water is necessary not only for the formation of milk, but also for the digestion and assimilation of the large quantities of food consumed, much of which is roughage. It is not wise to permit cows to drink large amounts of ice-cold water, and in order to encourage them to drink a sufficient amount of water in extremely cold weather it is necessary to warm the water slightly. The water trough should be kept clean and be so situated that the cows when drinking will not be exposed unnecessarily to extremes of weather.

THE STABLE.

Whenever possible the stable should be on high ground with good, natural drainage. Poultry houses, privies, hog sheds, manure piles, or surroundings which pollute the stable air and furnish breeding places for flies should not be near the cow stable.

The silo may be connected with the stable by a feed room, but this room should be shut off from the stable by a tight door. This is convenient and also prevents silage odors in the stable except at feeding time. After the silage has been fed the stable can be thoroughly aired before the next milking period.

An ideal site for a barnyard is on a south slope which drains away from the stable. If the barnyard is inclined to be muddy, it may be improved by drainage and by the use of cinders or gravel. A clean yard is a great help in keeping the cows from becoming soiled by mud and manure.

Very few farm buildings constructed 15 to 20 years ago meet the sanitary requirements of to-day. Bank barns are generally dark and damp, as the light is often excluded from one or more sides, thus making the stable difficult to keep clean. Stables which have basements open on one side for the manure furnish a breeding place for flies. Barns which have many exposed beams, braces, and ledges on which dust may lodge are undesirable. In these old types of buildings little or no attention was paid to proper ventilation and distribution of the light. Many of them, however, can at small expense be remodeled to meet all sanitary requirements.

Construction of the barn may be less important than careful methods in handling milk when the keeping down of the bacterial content of the milk is considered, but the barn construction may be such as to lighten the labor necessary to keep the barn and its equipment in a clean condition. (See fig. 3.)

The stable should have a hard floor which can be readily cleaned; for this reason a dirt floor is undesirable. A cement floor is easily cleaned and prevents waste of the liquid manure; it is liable to be cold, however, and therefore extra bedding is required for the cows to lie on.

The gutter back of the cows should be large enough to hold the droppings; a width of 16 to 18 inches and a depth of 7 inches are usually sufficient. The gutter should incline so as to drain readily, unless the liquid is taken up by absorbents. Types of stalls and mangers are best which present the least possible surface for collecting dust and dirt, and the least obstruction to the circulation of air. Stalls of wood have many flat surfaces and cracks which are difficult to keep

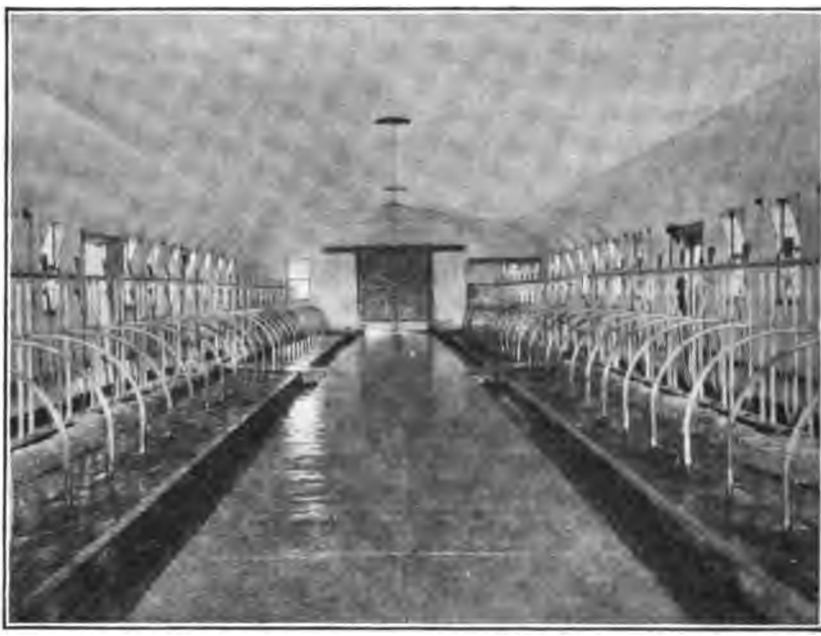

FIG. 3.—Interior of the dairy stable on the farm of the U. S. Naval Academy. The construction is such as to minimize the labor necessary to keep floor, walls, ceiling, and stable fittings in a clean and sanitary condition.

clean and in case of outbreaks of disease are not easy to disinfect thoroughly. Stalls made of metal pipes are therefore preferable. A swing stanchion is usually preferred, as it allows the cow plenty of freedom. A low, smooth manger without sharp angles is easy to keep clean. If the cows are tied, facing the center of the barn, the walk-way behind them should be 5 feet or more in width so the walls will not be soiled by spattering from the gutter and the manure carrier.

The most common defect in dairy stables is a lack of cleanliness: cobwebs on the ceiling and manure on the walls are too common in such places. The dairyman must not allow cobwebs, dust or dirt to accumulate if he expects to produce the highest grade of milk. With a tight, smooth ceiling and smooth walls without ledges, this is not difficult. Whitewash should be freely applied at least twice a year both to walls and ceiling, as it helps to purify the stable and to keep it light. An abundance of light is necessary; 4 square feet of glass per cow is generally sufficient if the windows are well distributed and not obstructed in any way. If the stable is located with its length north and south it receives the purifying benefit of both the morning and afternoon sun.

Every cow stable should have a system of ventilation to keep the air fresh and pure and the cows comfortable without exposing them to injurious drafts. If the smell in the stable is disagreeable at any time, it indicates that the ventilation is deficient. At least 500 cubic feet of air space should be provided for each cow. Farmers who desire to provide proper ventilation in cow stables can obtain information on this point by applying to the Dairy Division.

THE MILK HOUSE.

The building in which the milk is handled should be convenient to the barn but so placed as to be free from dust and stable odors. The ideal place for it is in a well-drained spot somewhat higher than the barn. It should not be near the barnyard, pig pen, privy, or other source of contamination. In cold climates it may be connected with the stable by a covered but well-ventilated passageway with self-closing doors at each end to prevent odors passing from the stable to the milk house. With proper precautions the milk house may be in the same building as the stable, but it should be provided with a separate entrance and the walls between should be tight and without a communicating door or window.

The principal purpose in building a milk house is to provide a place where dairy products may be handled apart from all other operations. To carry out this idea it is necessary to divide the interior of the building into two or more rooms in order to wash the utensils and handle the milk in separate rooms. The milk house and all its equipment should be so planned that unnecessary steps will be avoided and labor economized to the greatest extent. A plan for the milk house shown in figure 4 is given in Bureau of Animal Industry Circular No. 195.

Thorough cleanliness must always be kept in mind; therefore there should be no unnecessary ledges or rough surfaces inside the building, so that it can be quickly and thoroughly cleaned. Milk-house floors should be of concrete and pitched to drain through bell traps. Round edges at the walls will prevent the collection of dust and dirt. The walls and ceilings may be made of matched boards but cement plaster on painted metal lathing is better. Ventilators are necessary to keep the air in the milk room fresh and free from musty and other undesirable odors, and to carry off steam from the wash room. Windows are of prime importance, as they let in fresh air and sunlight, and facilitate work. In summer the doors and windows should be screened to keep out flies and other insects.

It is imperative that there be a plentiful supply of cold, running water at the dairy house. If it is not possible to have a gravity system the supply may be piped from an elevated tank fed by a hydraulic ram, engine, windmill, or hand pump. The dairyman can ill afford to spend his time in carrying water in a pail to cool his milk and wash his utensils. Provision must also be made for supplying an abundance of hot water to clean and wash utensils. The water supply should be clean and abundant as well as convenient;

FIG. 4.—A sanitary but convenient and inexpensive milk house built according to plans recommended by the U. S. Department of Agriculture.

otherwise the cleaning will not be thorough. Impure water is a source of contamination that under no circumstances should be allowed on a dairy farm. Outbreaks of typhoid fever in cities have been traced to dairy farms where the wash water was impure. Water which comes from shallow wells receiving surface drainage, or seepage from barnyard or house wastes or from pastures, is impure and should not be used.

UTENSILS.

All utensils which come in contact with milk should be made of durable, smooth, nonabsorbent material. Wooden utensils are hard to sterilize and therefore are not used in the best-equipped dairies. Badly battered or rusty ware is objectionable, as it is hard to clean, and contact with iron may injure the flavor of milk and milk products. Avoid all utensils having complicated parts, crevices, or inaccessible places which are hard to clean properly.

For the proper sterilization of utensils an abundance of steam or hot water is needed because at a few degrees above 100° F. the growth of the ordinary forms of bacteria ceases, although some exceptional forms grow at much higher temperatures. All disease-producing bacteria commonly found in milk are destroyed or rendered harmless on exposure to a temperature of 145° F. for 20 minutes. Some bacteria are able to withstand unfavorable conditions by passing into a resistant state known as spores, and these spores are killed only by long exposure to a temperature at or above that of boiling water. A pail or can may be clean to the eye and yet may carry numberless bacteria which will hasten the souring of milk, cause bad flavor in butter or cheese, or spread contagion. Milk utensils should be rinsed in cold water immediately after they have been used and before the milk has had time to dry upon them, then washed thoroughly in hot water to which soda or some washing powder has been added. Brushes are preferable to cloths for washing dairy utensils, as they are more easily kept clean and do better work.

After washing, the utensils must be rinsed and sterilized. For the latter they can be immersed in boiling water for at least two minutes or held over a steam jet for the same length of time, but the most effective method is to put them into a tight closet thoroughly sterilized with steam. The utensils while hot should be removed from the steam or water so that they will dry quickly from their own heat and until used should be kept inverted in a clean place, free from dust, flies, or other contamination. Strainer cloths can be washed in the manner above described, boiled for five minutes, and then hung in a clean place to dry.

MILKING.

Unless considerable care is taken, large numbers of bacteria may find their way into the milk during the process of milking. Cows should be milked in clean, well-lighted stables. It may be possible by taking great pains to produce good milk in a dark or dirty stable, but it is extremely improbable that clean milk will be produced under such conditions by the average person. Grooming and feeding the cattle, as well as cleaning the stable and removing the manure, should not be done just before milking, as these operations fill the air with odors, dust, and bacteria which may contaminate the milk. After grooming and before milking, the udders, flanks, and bellies of the cows should be carefully wiped with a damp cloth to remove any dust or loose hairs which might fall into the milk pail. In some dairies where milk containing an exceptionally small number of bacteria is produced, the cow's udders are washed twice in clean water and then wiped with a clean cloth. Only those persons who are free from communicable disease should be allowed to handle milk or even enter the stable or dairy house.

After the cows are prepared for milking, each milker should thoroughly wash his hands and put on a pair of clean overalls and a jumper, or wear a suit, preferably white, which is used for no other purpose. The suit must be kept clean and occasionally sterilized with steam or hot water. It is best to use a clean milking stool to avoid soiling the milker's hands.

In modern dairies where clean milk is produced the small-top milk pail is a necessity, as such a pail presents only a small opening into which dust and dirt may fall from the air or from the cow's body. It has been found by experience that the use of the small-top pail greatly reduces the number of bacteria in milk from average dairies. Many types of milk pails are for sale, but any tinner can convert an ordinary pail into a small-top pail by the addition of a hood, as shown in figure 5.

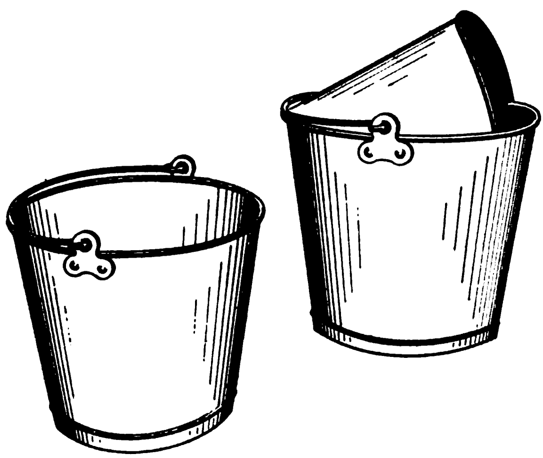

FIG. 5.—Open and small-top milk pails.

Milkers should be allowed to milk only with dry hands. The practice of wetting the hands with milk is a filthy habit and is liable to cause the cows' teats to chap in the winter time. Milking should be done quickly and thoroughly, with no violent jerking of the teats. After each cow is milked the pail of milk should be removed immediately to the milk house.

The milker should remember always that he is handling a human food which is very easily contaminated. Soap, clean water, and towels must be readily accessible. The hands should be washed after milking each cow.

HANDLING THE MILK.

When the milk is taken to the milk house it should be weighed, strained, and cooled at once. The object of weighing is to keep the records of the yield of each cow so as to eliminate the unprofitable cows from the herd. All milk should be strained to remove any dirt that may have fallen into it. This is best done through a layer of sterilized absorbent cotton between two cloths, or through several thicknesses of cheese cloth or similar material. A supply of strainer cloths should be ready for use at all times so that when one becomes soiled another can be substituted immediately. They should be treated after each milking as described on page 13.

From time to time samples of milk from each cow should be taken and tested with the Babcock tester to determine the percentage of fat. While cooling and in storage the milk cans should be kept covered to prevent the entrance of dust, dirt, insects, and other extraneous substances. Warm fresh milk should not be mixed with the cold milk of the previous milking, as such a practice results in warming up the milk which has been previously cooled.

FIG. 6.—Homemade cement tank for cooling milk and cream.

In all cases of doubtful purity milk should be pasteurized in order to protect the consumer from dangers that might be incurred by using such milk in the raw state. Pasteurization, however, is not recommended as a substitute for sanitary precautions but as a safeguard in using milk that is not known to be pure enough to be used raw with safety. Pasteurization is best done by heating milk for 30 minutes at a temperature of 145° F. This destroys the bacteria which cause tuberculosis and most other serious diseases, but it does not destroy all the bacteria which produce acid. The process of pasteurizing should not be confused with that of sterilizing, which means absolute destruction of all bacteria.

To retard the growth of bacteria milk must be cooled immediately to 50° F. or lower if possible. Ordinarily this can be done most satisfactorily by placing the cans in a tank, preferably concrete (see fig. 6), containing enough ice and water to come well up on the neck of the can. The cooling will be hastened if the milk is frequently stirred with a clean stirrer. Milk can be cooled more rapidly if it is run over a cooler inside of which is cold, running water, but if the air is not pure it will contaminate the milk. The milk should be kept in ice water until it is loaded on the wagon to go to the station or receiving plant. Bottled milk may be kept cold during transportation by the use of cracked ice placed in the crates. Cans of milk must be protected from the heat of the sun by jackets or by blankets which will help keep the milk cool and in winter a covering is needed for the milk to prevent freezing.

LIST OF AVAILABLE PUBLICATIONS RELATING TO THE DAIRY.

The following is a partial list of publications which are available for distribution and which will be mailed to those who apply to the department for them:

Farmers' Bulletin 22. The Feeding of Farm Animals.
55. The Dairy Herd: Its Formation and Management.
106. Breeds of Dairy Cattle.
206. Milk Fever and Its Treatment.
349. The Dairy Industry in the South.
363. The Use of Milk as Food.
413. Care of Milk in the Home.
459. The House Fly.
461. Concrete on the Farm.
463. The Sanitary Privy.
473. Tuberculosis.
480. Practical Methods of Disinfecting Stables.
490. Bacteria in Milk.
540. The Stable Fly.
578. The Making and Feeding of Silage.
589. Homemade Silos.

SCORE CARD FOR SCORING DAIRY FARMS.

The score-card system of rating dairy farms has been found to be one of the best methods of teaching dairy students the science of dairy sanitation, as all the important items are brought together in a convenient form. It is also of assistance to the dairy farmer, as it calls attention to each item of his equipment and methods separately, and thereby enables him to comply with the requirements of milk inspectors. The following is the score card used by the Dairy Division:

Equipment.	Score. Perfect.	Score. Allowed.
COWS.		
Health	6	....
Apparently in good health.. 1		
If tested with tuberculin within a year and no tuberculosis is found, or if tested within six months and all reacting animals removed 5		
(If tested within a year and reacting animals are found and removed, 3.)		
Food (clean and wholesome)	1	....
Water (clean and fresh)	1	....
STABLES.		
Location of stable	2	....
Well drained 1		
Free from contaminating surroundings 1		
Construction of stable	4	....
Tight, sound floor and proper gutter 2		
Smooth, tight walls and ceiling 1		
Proper stall, tie, and manger 1		
Provision for light: Four sq. ft. of glass per cow	4	....
(Three sq. ft., 3; 2 sq. ft., 2; 1 sq. ft., 1. Deduct for uneven distribution.)		
Bedding	1	....
Ventilation	7	....
Provision for fresh air, controllable flue system 3		
(Windows hinged at bottom, 1.5; sliding windows, 1; other openings, 0.5.)		
Cubic feet of space per cow, 500 ft 3		
(Less than 500 ft., 2; less than 400 ft., 1; less than 300 ft., 0.)		
Provision for controlling temperature 1		
UTENSILS.		
Construction and condition of utensils	1	....
Water for cleaning	1	....
(Clean, convenient, and abundant.)		
Small-top milking pail	5	....
Milk cooler	1	....
Clean milking suits	1	....
MILK ROOM OR MILK HOUSE.		
Location: Free from contaminating surroundings	1	....
Construction of milk room	2	....
Floor, walls, and ceiling.... 1		
Light, ventilation, screens.. 1		
Separate rooms for washing utensils and handling milk	1	....
Facilities for steam	1	....
(Hot water, 0.5.)		
Total	40	....

Methods.	Score. Perfect.	Score. Allowed.
COWS.		
Clean	8	....
(Free from visible dirt, 6.)		
STABLES.		
Cleanliness of stables	6	....
Floor 2		
Walls 1		
Ceiling and ledges 1		
Mangers and partitions 1		
Windows 1		
Stable air at milking time	5	....
Freedom from dust 3		
Freedom from odors 2		
Cleanliness of bedding	1	....
Barnyard	2	....
Clean 1		
Well drained 1		
Removal of manure daily to 50 feet from stable	2	....
MILK ROOM OR MILK HOUSE.		
Cleanliness of milk room	3	....
UTENSILS AND MILKING.		
Care and cleanliness of utensils	8	....
Thoroughly washed 2		
Sterilized in steam for 15 minutes 3		
(Placed over steam jet, or scalded with boiling water, 2.)		
Protected from contamination 3		
Cleanliness of milking	9	....
Clean, dry hands 3		
Udders washed and wiped. 6		
(Udders cleaned with moist cloth, 4; cleaned with dry cloth or brush at least 15 minutes before milking, 1.)		
HANDLING THE MILK.		
Cleanliness of attendants in milk room	2	....
Milk removed immediately from stable without pouring from pail	2	....
Cooled immediately after milking each cow	2	....
Cooled below 50° F.	5	....
(51° to 55°, 4; 56° to 60°, 2.)		
Stored below 50° F.	3	....
(51° to 55°, 2; 56° to 60°, 1.)		
Transportation below 50° F.	2	....
(51° to 55°, 1.5; 56° to 60°, 1.)		
(If delivered twice a day, allow perfect score for storage and transportation.)		
Total	60	....

Equipment .... + Methods .... = ...Final Score.

NOTE 1.—If any exceptionally filthy condition is found, particularly dirty utensils, the total score may be further limited.

NOTE 2.—If the water is exposed to dangerous contamination, or there is evidence of the presence of a dangerous disease in animals or attendants, the score shall be 0.

THE ESSENTIAL FACTORS IN PRODUCING A CLEAN, SAFE MILK.

Clean, healthy cows kept in clean, light, well-ventilated stables.
Stable so constructed as to be easily cleaned.
A clean, well-drained barnyard.
Clean utensils, thoroughly sterilized.
Clean, healthy milkers that milk with dry hands.
A small-top milking pail.
Immediate cooling of the milk to 50° F. or lower.
Storage of milk at a low temperature until delivered.
A separate house for handling the milk.
An abundant supply of pure water.

Further information concerning the production of clean milk or the planning and remodeling of dairy buildings can be obtained by applying to the Dairy Division of the Bureau of Animal Industry, Department of Agriculture.

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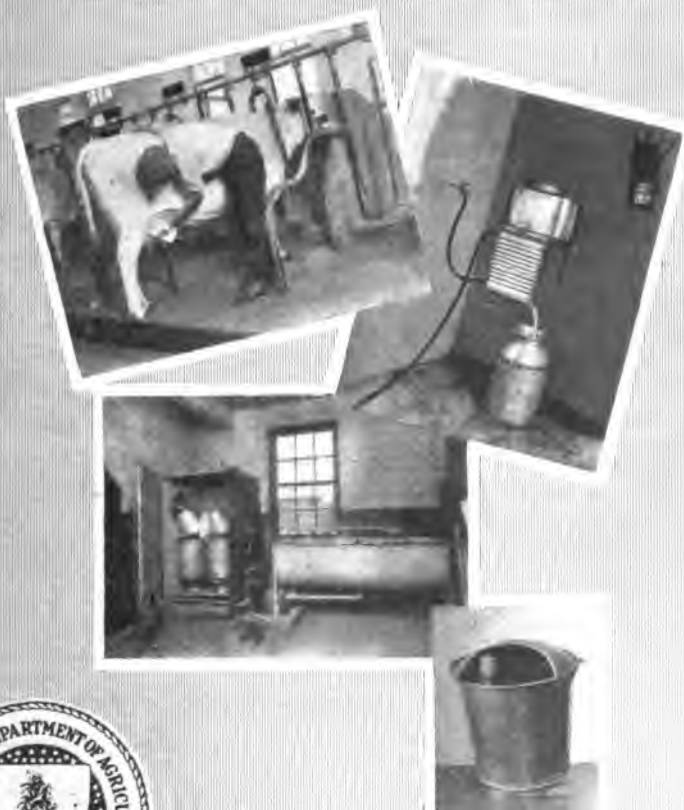
U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 602

PRODUCTION of CLEAN MILK



CLEAN MILK, as meant in this bulletin, is milk that comes from healthy cows, is of good flavor and free from dirt, and contains only a small number of bacteria, none of which are harmful.

Disease-producing bacteria which get into milk are most likely to come from unhealthy cows, unhealthy persons who do the milking, contaminated water, flies, or filth.

Great numbers of bacteria may get into the milk from the body of the cow and from utensils which have not been treated with heat (steam or boiling water) or a chlorine solution.

The number of bacteria may be kept at a minimum in milk by cleaning the cows, by using small-top milk pails, and by thoroughly washing the utensils and then treating them with heat or a chlorine solution.

Prompt cooling and storage at low temperatures retards the growth of bacteria in the milk. Milk so handled keeps better and makes products of a higher quality.

Clean, well-constructed stables, and separate milk rooms for handling the product, are important factors in the production of clean, wholesome, high-quality milk and cream.

Washington, D. C. **Issued August, 1914; revised April, 1931**

PRODUCTION OF CLEAN MILK

By Ernest Kelly, *Chief, Division of Market-Milk Investigations*, and C. J. Babcock, *Market-Milk Specialist, Division of Market-Milk Investigations, Bureau of Dairy Industry*[1]

CONTENTS

WHAT IS CLEAN MILK?

STRICTLY SPEAKING, the term "clean" would exclude milk which contains any foreign matter or bacteria whatever. However, for practical purposes, "clean milk" is defined here as milk that comes from healthy cows, is of good flavor and free from dirt, and contains only a small number of bacteria, none of which are harmful.

IMPORTANCE OF PRODUCING CLEAN AND WHOLESOME MILK

THE PRODUCER'S INTEREST

Every year the dairy farmers of the United States suffer heavy financial losses because too large a proportion of the products which they market is lower in quality than it should be. It is conservatively estimated that they could add many millions of dollars annually to their income, simply by giving attention to those factors which make for high quality of product. Sour and off-flavored milk and cream are not readily marketable, and when the dairyman does find a market the price he gets is usually low as compared with what he might get for a product of high quality. Furthermore, the products made from low-quality milk and cream are usually low in quality, so the losses from low-grade milk and cream extend all along the line. On the other hand, milk and milk products of high quality not only bring better prices but tend to increase consumption and thereby extend the dairymen's market.

[1] The original edition of this bulletin was written by Ernest Kelly.

In the flush season of milk production dealers have the opportunity to select their supplies upon a quality basis. When the flush occurs those producers who offer low-quality milk are the ones who are weeded out of the best market. Low-quality milk is what the buyer rejects first. High-quality milk retains the market.

On the farm the milkers and all people who handle milk should realize that they have in their charge a food which is easily contaminated. Safeguarding the wholesomeness of the milk supply on the farm protects the health of the farm family, who use a part of the milk, and also protects the health of the calves, which live largely on milk.

Healthy cows to breed from, and pure milk to feed, are two important factors in rearing thrifty calves and in the development and maintenance of a healthy and profitable herd.

THE CONSUMER'S INTEREST

Until recently, milk was generally considered as a food for only infants and invalids. Milk is necessary for the growing child, and the adult has learned that milk is one of the most valuable of foods, because it is nourishing, economical, and easily digested. The consumer, however, will demand milk as a food only when he has confidence in its wholesomeness. Serious epidemics of typhoid fever, septic sore throat, and other diseases have been spread through milk which was not carefully produced or properly pasteurized. Evidence indicates that tuberculosis may be transmitted from animals to human beings, chiefly young children, by the consumption of raw milk containing tubercle bacilli. (Raw milk is milk that has not been pasteurized.) Health is endangered not only by milk that contains specific disease-producing bacteria, but also by milk that contains large numbers of certain other kinds of bacteria which may cause serious digestive troubles, especially in infants and invalids. Another consideration is the loss to the consumer from milk souring or otherwise spoiling before it can be used. The cleaner the milk the longer it can be kept in sweet, wholesome condition.

BACTERIA IN MILK

Bacteria are single-celled plants which are so small they can not be seen with the naked eye.

All milk, unless produced under very exceptional circumstances, contains some bacteria.

Milk furnishes ideal conditions and food material for bacterial growth. Some bacteria, at maturity, divide to form two bacteria, and under favorable conditions the two new individuals may become full-grown and repeat the process of division in from 20 to 30 minutes. The bacteria commonly found in milk multiply most rapidly at temperatures between 80° and 100° F., At 70° F. the rate at which the bacteria multiply is slower. At 50° F. the rate is still slower. At 40° F. and below the rate is very slow. However, a few kinds of bacteria continue to multiply even at the freezing point.

Many of the kinds of bacteria ordinarily found in milk cause no apparent change in the milk. Other kinds may change the flavor without changing the appearance. Some of the most common types of bacteria cause marked changes in both appearance and flavor. In the latter class are the bacteria which sour milk by converting the milk sugar into lactic acid, and those which cause the formation of a sweet curd. Another type of bacteria decomposes the casein and albumin in the milk and causes putrefaction and undesirable odors.

The number of bacteria in milk depends upon the number of bacteria in the udder of the cow, upon the amount of contamination from outside sources, and upon the rapidity or the rate at which the bacteria increase in number.

It is very important to bear in mind that the rate at which bacteria grow and increase in number depends very largely upon the temperature at which the milk is kept.

KEEP DISEASE-PRODUCING BACTERIA OUT OF THE MILK

HEALTHY COWS

Tuberculosis probably is the most dangerous and widespread disease of cattle that can endanger the safety of milk. Tuberculosis is infectious. It spreads in a herd from cow to cow. As the disease develops slowly a cow may be affected with it for several months or even years before any marked physical changes in the animal are noted.

The total economic loss from tuberculosis is enormous. It amounts to millions of dollars a year. But far more important than this is human health.

Tuberculosis in dairy cows, especially in the udder, may be the source of tuberculosis in human beings. Most of the tuberculosis in children is in the bones, joints, and digestive tract, a fact which leads to the theory that milk may be one of the chief causes.

Have a capable veterinarian test the cows for tuberculosis at least once a year; and if disease is found, test twice a year. Remove from the herd all cows which react to the test, and disinfect the stable and premises thoroughly. See that all animals purchased for the herd are tuberculin-tested and free from the disease before they are brought to the farm. Keep them separate from the other animals for at least 60 days, and retest before placing them with the herd.

Infectious abortion of cattle is the cause of great losses to the cattle industries, and has a significance, of as yet undetermined importance, in respect to human health. This disease in cattle, and also in swine, is caused by a germ commonly known as *Bacterium abortus* or *Brucella abortus*. This germ has been found to sometimes cause undulant fever in man, the disease being acquired either through the consumption of the raw milk from abortion-infected cows or through contact with infected cattle or swine, or the carcasses of the latter. To avoid danger from this disease, milk should come from herds that are free from infectious abortion, or it should be pasteurized. The presence of infectious abortion in cattle may be detected by the use of the agglutination test for this disease. Infected herds may be freed from infectious abortion through the segregation and elimination of all reacting animals.

Milk that is slimy, ropy, or watery, or abnormal in any respect, or which comes from an animal that appears to be sick or out of condition, should not be consumed by human beings. As a rule, for

15 days before a cow calves and for 5 days after she calves, her milk should not be used as human food. It is well not to use milk from cows that have been given powerful drugs which may pass into the milk.

HEALTHY MILK HANDLERS

Some communicable diseases which do not originate with the cow may be carried by milk. The bacteria causing these diseases drop into the milk, are introduced unknowingly by the milker, are carried by flies, or come from the contaminated utensils.[2] Many of these bacteria grow in milk, and milk-borne epidemics have been caused by them. Some of the diseases which may be carried by milk are tuberculosis, typhoid fever, diphtheria, scarlet fever, and septic sore throat. The bacteria which cause these and some other diseases can be carried by people who are apparently well or well enough to work. Great care must be taken to have only healthy people handle the milk or anything with which the milk may come in contact. No one should go from a sick room where an infectious disease exists to take part in any of the operations where the milk is produced, handled, or kept.

PURE WATER

All the water on the farm should be pure, even that to which only the cattle have access. The farmer owes this protection to his family, to his business interests, and to the people who use the milk from his dairy. If cows wade in polluted water, disease bacteria, especially those causing typhoid fever, may adhere to them and later fall into the milk pail. Be sure that the water that is used for washing milk pails and other utensils is pure.[3]

DISPOSAL OF MANURE AND OUTHOUSE DEPOSITS

Disease may be spread from farm to farm and milk may become infected if care is not taken in the disposal of wastes from human beings and domestic animals. Disease-producing bacteria may be carried from exposed excreta by flies, rats, birds, etc., or they may be washed into the water supply. Stable manure and outhouse deposits should be disposed of in such a way that there is no possibility of their being a source of contamination of the milk.

Whenever possible, haul stable manure directly to the field and spread at once. When this is not feasible, put it in a covered storage pit or bin at a safe distance from the stable and milk house. Such treatment of manure not only protects health but saves valuable fertilizing materials. Figure 1 shows how manure is promptly removed from the barn on one good dairy farm.

The disposal of human excreta is highly important and can be easily accomplished in a number of ways. Indoor toilets, either chemical or connected with a sewer, are practical for farm homes. If outdoor privies are used they should be of sanitary type,[4] and the accumulations of material should be removed frequently and be either burned, treated with powerful chemicals, or buried.

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[2] The term "utensil" as used in this bulletin refers to any appliance which comes into contact with milk or cream during production or handling, such as milk pails, strainers, cans, separator parts, milk bottles, etc.

[3] Write your State board of health for information concerning farm water supplies.

[4] Write your State board of health for information concerning the construction and maintenance of sanitary privies.

CONTROL OF FLIES

Flies may carry millions of bacteria on their feet and bodies. They contaminate milk if they get on the utensils. They also mar the appearance of equipment, walls, ceilings, and windows, and annoy the animals and caretakers. They are attracted by the cattle, piles of manure, spilled milk, and other feeding or breeding grounds. Flies breed in moist, decaying vegetable matter, especially manure.

Keep corners of stalls clean, and clear away any feed there may be under the mangers. Early in the spring remove straw that has been banked around the watering troughs and buildings. In warm weather haul away the droppings from the lanes and yards every week. Where manure is piled in the open, haul it away at least once a week, from early spring until winter. Flies breed very freely in calf manure, particularly if the calves are fed milk in any form. It is advisable to remove calf manure twice a week. Take away all the fine loose material under manure piles. This material is likely to be heavily infested, as the fly larvæ work toward the outer edge and bottom of the piles.

FIGURE 1.—A simple and efficient way to handle manure on a small dairy farm. The prompt removal of the manure from the barn directly to the field avoids loss of manure and also keeps the barnyard clean

Immediately after the manure is removed, treat the ground that was under the pile with a 28–32 gravity fuel distillate (fuel oil), at the rate of 5 gallons to 100 square feet. This will kill the larvæ that have gone into the ground and may prevent others from going into the ground for some time. This distillate need be used but once every two or three weeks. Do not apply it directly on the manure because it contains substances that are injurious to plant growth.

Flies will find some place to breed even though conditions are not the most favorable. They may be killed by trapping and spraying.

The house fly is easily trapped. Put the traps in places where the flies gather, preferably on the floor, where air currents are not strong and where the light is good. The kind of bait is important. Either sugarcane blackstrap molasses or corn sirup mixed with water in the proportion of 1 part to 4 parts of water is effective. Watermelon rinds, crushed fruit, skim milk, and some of the grain feeds may be used, but they must be renewed oftener. Renew the bait, and thoroughly clean the pans every two or three weeks, or more often if mold starts to form on the bait. When adding bait, examine the cone of the trap for spiders.

Empty the traps regularly, as flies do not enter them readily when they become too full. The flies may be killed by steaming the traps in the steam box for three to five minutes. This will kill the live flies and loosen any dirt there may be in the trap. If steam is not available, either put the traps in water for a few minutes or pour hot water over them. Then wash the traps and allow them to dry in the sun before replacing them over the bait pans.

Spray the places where the flies gather. Do this early in the morning when the flies are somewhat sluggish, and late in the afternoon after they have fed and gathered for the night. Also spray their feeding places after large numbers have gathered on them. When flies are unusually annoying to the cows it may be well to spray the animals. Do not force the spray directly into the hair. Direct the spray parallel to the animals so as to hit the flies as they rise. Do not brush the cows for some time afterwards. Horn flies must be sprayed while on the cattle, as they stay in no other place long enough to be hit with the spray.

Use a sprayer of good size, capable of standing a pressure of 35 to 40 pounds, with a nozzle that will throw a heavy, fully atomized spray over a considerable area. An 8-foot bamboo extension will allow the operator to reach the ceilings and out-of-the-way places. If the manure is hauled away promptly, thorough spraying need be done only three times a week.

A good killing spray can be made as follows: Put 5 pounds of unground, half-closed pyrethrum flowers in a double-thickness cheesecloth container. Suspend this for 24 hours in a mixture of 9 gallons of kerosene and 4 quarts of fuel oil of 28–32 gravity. Some of the insecticide manufacturers sell a concentrated pyrethrum extract which needs only the addition of the kerosene and fuel oil.

PREVENT HIGH BACTERIAL COUNTS IN THE MILK[5]

Most of the bacteria in milk come from the body of the cow and from unclean milk utensils. Under certain conditions the bacteria may multiply until the number becomes very large. To keep the bacterial count low, keep the body of the cow clean, have all utensils thoroughly clean and sanitary, use small-top milk pails, keep flies and all sources of bacterial contamination away from the milk, and cool the milk promptly after milking and keep it cool.

[5] The bacterial count is the number of bacteria found in a cubic centimeter, and is determined by allowing the bacteria from a definite quantity of milk to grow on a culture medium and counting the number of colonies, each of which represents the growth from one bacterium.

CLEAN COWS

The body of the cow, especially those parts of the belly, flanks, and udder that are immediately above the milk pail, may be the source of bacterial contamination, because manure, loose hairs, bedding, and other foreign matter may fall into the milk pail. Samples of fresh manure have been found to contain nearly 50,000,000 bacteria per gram. (There are 453.6 grams in a pound.)

Have the cows clean at milking time. Cows usually keep cleaner when they are on pasture than when kept in the barn, but although they appear to be clean they may be very dusty and therefore need to be brushed. (Fig. 2.) When the cows are in stables clean them

FIGURE 2.—Cleaning the cows in a modern dairy barn. Cleaning the cow is the first main step in the production of high-quality milk

thoroughly at least once a day. Clip the long hairs from their udders, flanks, and tails in order that dirt may not cling to them. Before milking, carefully wipe the udders, flanks, and bellies with a clean, damp cloth to remove dust and loose hairs. If these parts are very dirty, wash them. Plenty of bedding, good stables, and frequent removal of manure will help to keep the cows clean.

In an experiment made by the Bureau of Dairy Industry, fresh milk from dirty cows had an average bacterial count of 55,208 per cubic centimeter, whereas fresh milk from clean cows with udders and teats washed averaged only 4,947 per cubic centimeter. (A cubic centimeter is about 16 drops.) Open-top milk pails, thoroughly washed and treated with steam, were used.

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SMALL-TOP MILK PAILS

Most of the dirt that gets into milk falls from the cow into the pail at milking time. There are fewer bacteria and there is less sediment in the milk when the small-top pail is used, than when an open-top pail is used. An experiment showed that the average number of bacteria per cubic centimeter in 30 samples drawn into a small-top pail was 29,263, whereas with the same number of samples drawn into an open pail the average was 87,380.

The small-top pail should be durable, have smooth seams, be easy to milk into, be easy to clean, and have only a small opening. A number of types of small-top pails are on the market. Any tinner can convert an ordinary open-top pail into a small-top pail at little cost, by putting on the hood shown at the right in Figure 3.

WASHING AND THEN TREATING UTENSILS WITH HEAT OR A CHLORINE SOLUTION

Utensils which have not been properly washed and treated to kill bacteria contain large numbers of bacteria. Indeed, dirty utensils are usually the source of most bacteria found in market milk at the time of production and before bacterial growth has begun. Experiments have furnished convincing proof of the fact that milk is contaminated by utensils that have not been subjected to heat or to treatment with a chlorine solution. In an experiment milk drawn into pails which had been thoroughly steamed had an average of only 6,306 bacteria per cubic centimeter, whereas samples from pails which had not been steamed averaged 73,308.

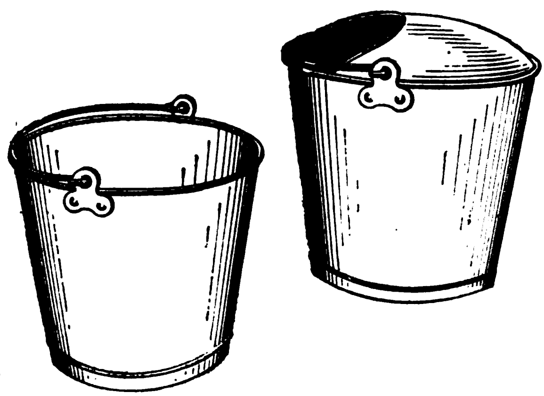

FIGURE 3.—Open-top and small-top milk pails

Many of the bacteria which get into milk from utensils are of undesirable types. Some of them cause milk to putrefy and undergo changes that may make it dangerous to health. If utensils have been washed in contaminated water and are not treated to destroy bacteria, disease bacteria may get into the milk.

Tightly covered milk or cream cans which have not been effectively treated with heat or a chlorine solution and dried give off foul odors after having stood for awhile. This is due to the action of the decay-causing bacteria on particles of milk solids left in the cans. If these cans are washed and thoroughly treated with heat or chlorine the foul odor will disappear. Utensils should be washed and subjected to heat, or a chlorine solution immediately after use to prevent the multiplication of great numbers of bacteria on their inner surfaces. In one experiment made by the bureau, milk contained 666,520 bacteria per cubic centimeter after coming in contact with utensils which had not been treated with heat or a chlorine solution, even though they had been washed immediately after milking. In similar experiments, in which utensils were washed eight hours after they were used, the average bacterial count of the milk was 1,667,000, or more than a million greater than when the utensils were washed immediately after using.

Utensils should first be washed thoroughly, and then be further treated with heat or a chlorine solution to kill bacteria.

Rinse the utensils in cold or lukewarm water, then wash them with hot water, an alkali washing powder, and a stiff brush, until they are thoroughly clean. Next rinse them with clean water. Do not use rags, greasy soaps, or soap powders.

To kill the bacteria on the utensils, treat the utensils with steam or a chlorine solution, or immerse them in water and boil for 5 to 10 minutes. The last method, however, is cumbersome.

STEAMING UTENSILS

Where steam is used, equipment for this purpose should be installed. A metal tank mounted on a brick or masonry foundation, as shown in Figure 4, is satisfactory for small dairies. The tank has a false bottom. Enough water for washing utensils is put into the tank and then the fire is built. When the water is hot most of it is drawn off to use for washing, the amount remaining being only about an inch deep, and the water level is below the false bottom. After the utensils are washed they are placed in the tank on the false bottom. Then the tank is tightly covered. Steaming for 30 minutes is sufficient.

FIGURE 4.—Galvanized-iron box for heating water and for treating utensils to kill bacteria

A steam boiler furnishes the best source of heat for the heat treatment of utensils. The boiler may be connected with a cabinet[6] built of concrete, brick, stone, tile, metal, or wood. Steam the utensils in the cabinet for at least five minutes at a temperature of at least 200° F. They may be left in the cabinet until they are used.

Thorough drying of utensils after washing and steaming is extremely important. The steam coil in the bottom of the cabinet should give off enough heat to dry the utensils quickly.

To keep the temperature up to at least 200° F. the constant use of a thermometer is advised. As some types of apparatus generate steam

[6] Plans for the construction of a steam cabinet can be obtained free from the Bureau of Dairy Industry, U. S. Department of Agriculture, Washington, D. C.

slowly, the length of exposure at 200° F. should be noted rather than the time the cabinet is in operation.

CHEMICAL TREATMENT OF UTENSILS

The chemicals that are commonly used for treating utensils to kill bacteria are sodium hypochlorite, calcium hypochlorite (also known as chloride of lime) and chloramine preparations. These can be bought in packages of convenient size.

In making a solution of calcium hypochlorite, first make a smooth, watery paste of 12 ounces of chloride of lime, and then add water, first in small quantities and then in larger quantities until the solution amounts to 2 gallons. Strain this into a glass bottle or jar, and keep tightly covered in a cool, dark place. This is called the stock solution. To dilute this stock solution to the proper strength for using, add water to it at the rate of 8 gallons of water per pint of stock solution. This is the final rinse solution. Never keep this solution from one day to the next, but make it fresh every day, and use it only once.

Commercial powders, tablets, and solutions for treating utensils are now on the market. These may cost more than the homemade solution, but in using them it is not necessary to make the stock solution, as they are in a form ready to add to the rinse water.

It is very essential to wash and rinse utensils thoroughly before putting them in the chlorine solution. Chlorine, the active agent in these solutions, is affected by organic matter, and if milk, cream, or dirt is present the strength of the solution is weakened before the chlorine has a chance to attack the bacteria.

The effectiveness of the solution depends upon its strength and the length of time the utensils are left in it.

A strength of 1 part of chlorine to 5,000 parts water is recommended. Be sure that the utensils are entirely covered with the solution, and that they are immersed in the solution for at least two minutes. Eliminate all air pockets. Never rinse the utensils after using the chlorine solution. Turn the utensils upside down in a clean, dry place, free from dust and flies (preferably in the milk house), and do not touch them until they are needed.

THE MILKING MACHINE MUST BE SANITARY

The parts of the milking machine which need the most attention are the rubber tubing, teat cups and inflations, claw, pail, head, valves, and moisture trap.

The heat method is simple and effective. This method is as follows:

> Immediately after milking, rinse the machine with cold or lukewarm water drawn through it by vacuum. The flow of water may be broken occasionally by pulling the teat cups out of the water. Do this 10 or 12 times. Repeat this operation, using hot water containing washing powder, and wash the teat cups and tubing with a brush. Then rinse the machine by drawing clean hot water through it by vacuum.

Remove the long milk tube, with claw and teat cups, from the head of the pail. With a machine of the inflation type, plug the air tubes and put these parts in a tank or can. If steam is available, entirely cover all parts with clean water, and heat with steam to a temperature of 160° to 165° F. If steam is not available, heat the water on a stove, but do not put the rubber parts in the water while it is heating. Leave the parts in the water until the next milking, allowing them to cool slowly.

In treating the parts with chemicals, wash them as indicated above. Instead of putting the parts in hot water, however, put them in a chlorine solution, of the same strength as used for other utensils, and allow them to remain there until the next milking.

With either method the machine should be taken entirely apart at least twice a week and washed thoroughly with brushes and hot water containing washing powder.

The moisture trap, or check valve, on the head of the machine should be cleaned every day.

Milking-machine pails and covers should be thoroughly washed after every milking and then be further treated with heat or a chlorine solution to kill bacteria. If there are pulsators and electric motors on the head of the pail they should be removed before cleaning the machine.

The vacuum line should be cleaned at least twice a year, by drawing hot water containing washing powder through it with vacuum. The vacuum line should be cleaned immediately after milking if milk has been drawn into it.

COOL THE MILK PROMPTLY AND KEEP IT COOL

A large number of bacteria found in milk when it reaches the consumer are due to improper cooling and keeping the milk at too high a temperature during storage, transportation, and delivery. The rapidity with which bacteria multiply in milk at different temperatures is shown in Table 1.

TABLE 1.—*Growth of bacteria in milk when the milk is held at 50° and at 68° F.*

Temperature of milk	Number of bacteria per cubic centimeter—				
	At beginning	At end of 6 hours	At end of 12 hours	At end of 24 hours	At end of 40 hours
50° F	10	12	15	41	62
68° F	10	17	242	61,280	3,574,990

At the above rate, if the milk, when produced, contained 1,000 bacteria per cubic centimeter, the part held at 50° F. would have contained only 4,100 bacteria at the end of 24 hours, whereas that held at 68° F. would have contained 6,128,000. The effect of temperature on the growth of bacteria is graphically shown in Figure 5.

At a certain creamery, milk received in the morning consisted of the previous night's milk and the fresh morning's milk, which were kept separate. During the six warm months (April to September, inclusive) 478 samples of the morning's milk averaged 800,026 bacteria per cubic centimeter, whereas 366 samples of milk which had been held overnight on the farms averaged 2,406,357 bacteria.

A survey of the temperatures at which milk is received at railroad stations for shipment to market in summer, showed that the temperature of morning's milk averaged about 60° F. and in some cases it was as high as 80° F. These temperatures are much too high to permit milk to be shipped a considerable distance without souring. Frequently it was found that morning's milk was rushed from the farm to the station before it had been sufficiently cooled. A large part of the loss caused by the souring of milk is due to the shipping of the milk at too high a temperature.

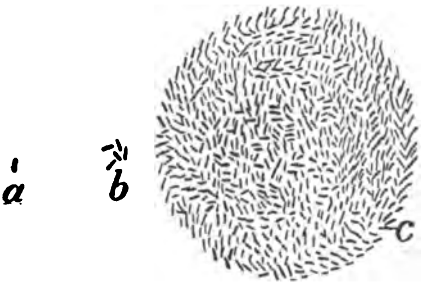

FIGURE 5.—This shows how rapidly bacteria multiply in milk that has not been properly cooled. In 24 hours a single bacterium (*a*) became 5 bacteria (*b*) in milk kept at 50° F. When the temperature of the milk was kept at 70° the single bacterium multiplied to the great number shown in (*c*) in the same length of time, 24 hours

Milk or cream must be cooled promptly to a temperature of 50° F. or below if rapid bacterial growth is to be prevented.

The use of a surface cooler (fig. 6) is especially necessary when the time between milking and shipping is short. If warm milk is run over a surface cooler supplied with the coldest available water and then set in a tank cooled with ice to 40° F. or below, it should not be difficult to cool the milk to 50° within an hour after it leaves the cow. A 10-gallon can of warm milk precooled with water at 55° F. and set in a tank of ice water at 37° F. can usually be cooled to 50° F. in about 20 minutes. The fact that precooling with a surface cooler is not practiced and that ice is not put into the cooling tank until after the milk is put there, is the reason why much milk reaches the shipping station in summer at so high a temperature that it sours on the way to the city.

FIGURE 6.—Milk cooler and concrete tank for cooling and storing milk and cream

Do not mix warm, fresh milk with cold milk of the previous milking, because the addition of warm milk to cold hastens bacterial growth by warming up the whole mass. Keep cans of milk covered to prevent the entrance of dust, dirt, insects, and other sources of contamination.

Cream sours more slowly than milk. Heavy, or rich cream does not sour as quickly as thin cream; therefore, ordinarily, the cream should test from 30 to 35 per cent butterfat. Such cream makes less bulk to handle, and leaves more skim milk on the farm than does thin cream.

Immediately after cream is separated, cool by the same methods advised for milk. If only a small quantity is handled, put it into tall cylindrical cans, called "shotgun" cans, and place these in ice water. Do not mix fresh cream with previous skimmings until it has been thoroughly cooled.

FIGURE 7.—Interior of a good dairy stable. Construction, equipment, lighting, ventilation, etc., of this kind make it easy to keep the floor, walls, ceiling, and stable fittings clean and sanitary

STABLE SHOULD BE CLEAN, WELL LIGHTED, AND WELL VENTILATED

Whenever possible the cow stable should be located on high ground with good natural drainage, and poultry houses, privies, hog sheds, manure piles, or other conditions which pollute the stable air and furnish breeding places for flies should not be close to it. A good location for a barnyard is on a south slope which drains away from the stable. If the barnyard tends to be muddy this may be remedied by drainage and by the use of cinders or gravel. A clean yard is a great help in keeping the cows clean. Figure 7 shows the interior of a substantial, practical, and well-constructed dairy barn, the plans and specifications for which were furnished by the Bureau of Dairy Industry.

The stable should have a hard, waterproof floor which can be easily cleaned. A dirt floor is very undesirable. A concrete floor is easy to clean and prevents waste of the liquid manure; however, such a floor tends to be cold but extra bedding will remedy this trouble. See that the gutter back of the cows is large enough to hold the droppings; a width of from 16 to 18 inches and a depth of 7 inches usually is sufficient. The gutter should slope so as to drain readily, unless the liquid manure is taken up by absorbents.

Types of stalls and mangers which have the least possible surface for collecting dust and dirt and offer the least obstruction to the circulation of air, are the most satisfactory. Wooden stalls have many surfaces and cracks which are hard to keep clean, and in case of disease they can not be disinfected as thoroughly as can stalls made of metal pipes. A swing stanchion is usually preferred, as it allows the cow plenty of freedom. A low, smooth manger without sharp angles is easy to keep clean. If the cows face the middle of the barn, the walk behind them should be 5 feet or more in width so that the walls will not be soiled by the spattering from the gutter or the manure carrier.

Tight, smooth ceilings and smooth walls without ledges are easily kept free from cobwebs, dust, and dirt. Cobwebs on the ceilings and manure on the walls are found in too many dairy stables. Unless walls and ceilings are painted, whitewash should be freely applied at least twice a year, as it helps to purify the stable and to keep it light.

A cow stable should be well lighted; 4 square feet of glass per cow is sufficient if the windows are well distributed and not obstructed in any way. If the stable is built with its length north and south, it gets the benefit of both the morning and afternoon sun.

The stable air should always be fresh and pure but should be free from drafts. If the odor in the stable is disagreeable at any time, it shows that the ventilation is poor. At least 500 cubic feet of air space should be provided in the stable for each cow.

MILK HOUSE SHOULD BE CLEAN AND CONVENIENT

The building in which the milk is handled should be convenient to the barn, but so located as to be free from dust and stable odors (fig. 8). The ideal place for it is in a well-drained location somewhat higher than the barn. It should not be close to the barnyard, pigpen, privy, or other source of contamination. The milk house may be connected with the stable by a covered, well-ventilated passageway with self-closing doors at each end to prevent stable odors from entering. It may be in the same building as the stable, but if so it should have a separate outside entrance and the walls should be tight and without a direct communicating door or window.

It is advisable to divide the milk house into two rooms, one for handling the milk and the other for washing the utensils. Plan the milk house and all its equipment so as to save as much labor as possible, not only in handling the product but in keeping the building clean.

There should be no unnecessary ledges or rough surfaces inside the building. The floors should be of concrete and pitched to drain through bell traps. Rounded edges at the walls prevent the collection of dust and dirt. The walls and ceilings may be made of matched boards, but smooth cement plaster on metal lath is better. Ventilators are necessary to keep the air in the milk room fresh and free from musty and undesirable odors and to carry off steam from the wash room. Windows are very important, as they let in fresh air and sunlight and make work easier. In summer the doors and windows should be screened to keep out flies and other insects.

A plentiful supply of cold, running water in the milk house is necessary. The supply may be piped from an elevated tank fed by a windmill, engine, hand pump, or hydraulic ram. The dairyman can not afford to spend his time in carrying water in a pail to cool the milk and wash the utensils. Provision must also be made for supplying an abundance of hot water for washing and treating the utensils.

FIGURE 8.—A sanitary and convenient milk house, built according to plans recommended by the United States Department of Agriculture. This type of house is not expensive

USE UTENSILS THAT ARE EASILY CLEANED

All milk utensils should be durable, smooth, and nonabsorbent. Wooden utensils are hard to keep free from bacteria and should never be used. Badly battered or rusty utensils are hard to clean, and the rusty iron may injure the flavor of the milk and milk products. Do not use utensils having complicated parts, crevices, or places that are hard to clean.

MILKERS SHOULD BE CLEAN

Just before milking, each milker should wash his hands with soap and water and put on a pair of clean overalls and a jumper, or a suit which is used for no other purpose. Enough suits should be provided so that a clean one is always available. They should be washed regularly, and occasionally they should be steamed or boiled. Even the milking stool should be kept clean to avoid soiling the milker's hands.

Milk only with clean, dry hands, or with a milking machine which has been properly cleaned and treated to kill bacteria. The practice of wetting the hands with milk is a filthy one; it adds bacteria and sediment to the milk, and in the winter it may cause the cows' teats to chap. Milk quickly and thoroughly, without jerking the teats.

Immediately after each cow is milked, take the pail of milk to the milk house. Never let it stand in the barn. The milker should always bear in mind that he is handling a human food which is very easily contaminated. Therefore, it is well for the milker to have soap, clean water, and towels accessible so he can wash his hands after milking each cow.

STRAIN MILK PROPERLY

After the milk is taken to the milk house, strain and cool it at once. The straining is best done through a layer of sterile absorbent cotton placed between two clean strainer cloths which have been steamed or boiled, or through special straining cloth. Straining milk improves its appearance but does not remove the bacteria carried into it by dirt; therefore, dirt should be kept out of milk by clean methods. Keep a supply of clean strainer cloths on hand at all times, so that when one becomes soiled it can be replaced immediately with a clean one. Use a strainer cloth for only one milking. Special strainer cloths may be bought at low cost from most dealers in dairy supplies.

KEEP FEED AND WEED FLAVORS OUT OF THE MILK

Milk is often made unsalable by feed and weed flavors. Feed flavors in milk are most frequently caused by succulent feeds. When fed to dairy cows one hour before milking, silage made from corn, alfalfa, sweetclover, or soybeans, and green alfalfa, cabbage, turnips, rape, and kale seriously affect the flavor and odor of milk. Green rye, green cowpeas, potatoes, dried beet pulp, and carrots affect the flavor and odor of milk only slightly, and green corn, green oats and peas, green soybeans, pumpkins, and sugar beets have practically no effect on the flavor and odor.

Feeds affect the flavor of milk only a few hours after they are eaten. For this reason, feed dairy cows highly flavored feeds immediately after milking and not just before. Aeration of milk by running it over a surface cooler immediately after milking reduces strong feed flavors and sometimes eliminates slight ones.

Eradicate from pastures all weeds which cause objectionable flavors in milk. Until this is done take the cows off infested pastures as long as possible before milking. The longer the interval between the removal of the cows from pasture and the time of milking, the less intense will be the undesirable flavors in the milk. In the case of garlic-infested pastures the cows should be taken off the pasture four to seven hours before milking to entirely avoid the garlic flavor and odor in milk. Some weeds, such as bitterweed, impart objectionable flavors to the milk several hours after they are eaten. If such weeds are present it may be neccessary to keep the cows off the pasture until the weeds are eradicated.

ADDITIONAL INFORMATION

The following United States Department of Agriculture publications have a direct bearing on the general subject of sanitation in milk production. A copy of any of these publications may be obtained, free of charge as long as the free supply lasts, by writing to one of your Senators or your Representative in Congress, or to the Office of Information, United States Department of Agriculture, Washington, D. C. Give both the title and the number of the publication. If more than one is wanted, list them numerically as is done below.

PUBLICATIONS

734–F, Flytraps and Their Operation.
954–F, Disinfection of Stables.
976–F, Cooling Milk and Cream on the Farm.
1069–F, Tuberculosis in Livestock: Detection, Eradication, and Control.
1097–F, The Stable Fly: How to Prevent Its Annoyance and Its Losses to Livestock.
1214–F, Farm Dairy Houses.
1227–F, Sewage and Sewerage of Farm Homes.
1315–F, Cleaning Milking Machines.
1393–F, Principles of Dairy-Barn Ventilation.
1408–F, The House Fly and How to Suppress It.
1422–F, Udder Diseases of Dairy Cows.
1426–F, Farm Plumbing.
1448–F, Farmstead Water Supply.
3–L, Improved Sanitation in Milk Production.
25–L, Preventing Feed Flavors and Odors in Milk.

(The above list was compiled as of March 1, 1931)

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FARMERS' BULLETIN

603

Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.
August 14, 1914.

ARSENICAL CATTLE DIPS:

METHODS OF PREPARATION AND DIRECTIONS FOR USE.

By ROBERT M. CHAPIN,
Senior Biochemist, Biochemic Division.

INTRODUCTORY.

This bulletin is intended to be a handbook for the user of arsenical cattle dips. It aims to include in brief but ample form general information, formulas, tables, and practical hints bearing on the preparation and management of arsenical dipping solutions. But to this field it is strictly limited. Those who desire a popular account of the life history of the Texas-fever tick and of its relation to cattle are referred to a previous bulletin (Farmers' Bulletin 498) issued by the department. The same, as well as another previous publication (Bureau of Animal Industry Circular 207), contains plans and specifications for the construction of dipping vats, together with directions for the management of cattle in connection with dipping.

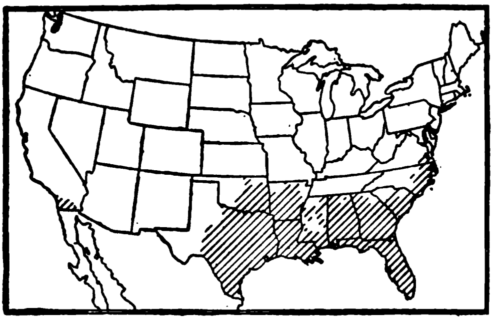

FIG. 1.—Map of the United States, the shaded area showing the territory to which this bulletin applies.

PROPERTIES OF SUBSTANCES USED IN MAKING DIPS.

Making a dip is simply a manufacturing proposition. No manufacturer can expect to get the best results unless he is somewhat acquainted with important facts regarding his raw materials.

White arsenic, also known as arsenic trioxid, arsenious or arsenous oxid or anhydrid, should always be purchased in the form of a fine powder, and under a guaranty of 99 per cent purity. Water, even when boiling, will dissolve only a little of it, and that slowly, but by the use of certain other chemicals white arsenic may be readily and abundantly brought into solution.

White arsenic is a violent poison, and users of it must never allow familiarity to beget carelessness. It may be absorbed into the system and cause injury or death, either through the mouth, the lungs, or the skin; therefore neither the dry powder nor the solution should be allowed to remain on the skin. The breathing in of dust arising from the dry powder during handling must be avoided, while, if cattle are being sprayed, neither the operator nor the cattle should inhale any of the spray. Moreover, from a boiling solution arsenic may be thrown out as a fine spray and also, under certain conditions, as the very poisonous gas "arsin." Hence, concentrated dips should be prepared only in thoroughly ventilated places, while all work should be done on the windward side of the kettle and as far from it as practicable.

If arsenic in any form has been swallowed, medical attention is to be obtained as soon as possible; but since promptness of action is of very great importance and medical attention is not always readily available, it is best for all who use arsenical dips to be familiar with first-aid treatment. The United States Dispensatory (nineteenth edition) has the following to say in this matter:

> If the antidote * * * be not directly at hand, free vomiting should be induced by the finger, the feather part of a quill, and the administration of an emetic; * * * Demulcent drinks should be freely given, such as milk, white of eggs and water, or flour and water, which serve to encourage the vomiting and to envelop the poison.
>
> The antidote having been faithfully applied, the subsequent treatment consists in the administration of mucilaginous drinks and the treatment of symptoms as they arise.
>
> * * * * * * *
>
> The antidote above referred to is * * * *ferric hydroxid with magnesium oxid in the moist or pulpy state.* As soon as it is ready it must be given in doses of a tablespoonful to an adult, of a dessertspoonful to a child, every five or ten minutes until the urgent symptoms are relieved. * * * Its efficacy is, of course, greater the sooner it is administered after the ingestion of the poison; but even after delay its use will prove advantageous so long as any portion of the poison still remains in the stomach. * * * It should be an invariable rule to prepare the antidote at the time it is wanted from materials always kept at hand. * * * The best antidote known is the combination of ferric hydroxid with magnesium oxid now recognized by the U. S. Pharmacopœia.

The materials for the antidote referred to can be supplied by any prescribing pharmacist, contained in two bottles. In this separated form the antidote keeps well, and when an emergency calls for its use all that is necessary is to mix thoroughly the contents of the two bottles and to administer as directed. But in any case medical attention must be obtained as soon as possible.

Sodium carbonate.—Also known as sal soda or washing soda, when fresh consists of colorless transparent crystals. On keeping, unless tightly closed from the air, it tends to lose its crystalline appearance and to fall to a white powder. This change is due merely to the fact that the crystals carry a large amount of combined water (water of crystallization), and on exposure to the air much of this water may evaporate with consequent destruction of the crystalline form. The soda itself is in no way affected by this loss of water, except that it really becomes stronger, weight for weight.

Another form of sodium carbonate, called "monohydrated sodium carbonate," also occurs in commerce in the form of a white crystalline granular powder. It contains only a small amount of water of crystallization and is practically unaffected by exposure to air. This form of soda from a manufacturing point of view is far preferable to sal soda, as it is of constant and permanent composition, and being much stronger, weight for weight, it is less expensive to handle. When using monohydrated soda it is necessary to remember that only 4½ pounds are needed to do the same work as 10 pounds of sal soda.

Pine tar.—Pine tar when fresh is semiliquid, but with age becomes granular and nearly solid, in which condition it is of less value. Mixed with it is always more or less water of decidedly acid properties (pyroligneous acid), which on standing tends to float on the surface and should be dipped or poured off before the tar is used.

Tar is heavier than water and when stirred with it usually forms a very poor mixture from which most of the tar rapidly settles out, but when the water is of just the right temperature and somewhat alkaline a fairly stable suspension may generally be obtained. When previously treated with an amount of caustic alkali sufficient to combine with a considerable proportion of the tar acids, or when blended with soap, the tar easily mixes with water and then forms a good and permanent emulsion.

Caustic soda.—Also known as sodium hydroxid, or sodium hydrate, on account of its wide range of application by chemists, pharmacists, and manufacturing industries occurs commercially in a number of different forms, as powder, flakes, solid masses, or broken fragments; in color ranging from pure white to grayish or brownish tints. For the use of chemists and pharmacists it is put up in glass bottles; for industrial purposes it is supplied in various sized cans or drums of thin sheet iron. The latter is the variety that should be purchased for making dip. Its large output and wide use render it easily obtainable almost everywhere—far more so than white arsenic. The 10-pound can is the best size to buy for home use in preparing dips; larger consumers can probably handle the material in larger drums conveniently and of course more economically. The purchaser must make sure that the contents of the drum he contemplates buying are in fragmentary form, or granulated, for much caustic soda is run into drums in a melted condition and on cooling forms a single solid cake, which, though satisfactory for factory use, is not adapted for the present purpose. It should always be purchased under a guaranty of not less than 85 per cent actual caustic soda.

Caustic soda is an intensely active and powerful substance. When exposed to the air it strongly attracts moisture, increasing in weight and becoming pasty, while at the same time it becomes contaminated with sodium carbonate through absorption of carbon dioxid. Hence it must always be purchased in original containers, never in bulk; the container must not be opened until just before the material is to be used; the substance must not be allowed to stand exposed to the air, and if any is left over which is to be kept for subsequent use it must be immediately transferred to a tin pail provided with a tightly fitting cover, such as a lard pail, or, best of all, a paint pail with a friction top.

Owing to the intense chemical activity of caustic soda it is extremely corrosive in its effect upon skin or clothes, and upon the lungs if dust from it is inhaled. Therefore it is necessary to handle it gently to avoid the raising of dust and to wash off at once with water any which may touch the skin or clothing.

Caustic potash.—Also known as potassium hydroxid or hydrate, is very similar in its properties to caustic soda. It is not, however, so widely used industrially, and is decidedly more expensive without being any better for the present purpose. Therefore it should be purchased only when caustic soda happens not to be available. In its use one must remember that, weight for weight, it is less efficient than caustic soda, so that for every pound of the latter there must be employed 1.4 pounds of caustic potash. Like caustic soda, it must be guaranteed at least 85 per cent pure.

Lye.—This is a term employed to designate a grade of caustic soda put up primarily for domestic use, such as making soap from waste grease and for general cleansing. Since ordinary buyers of this grade of goods are not apt to be able to judge closely of its quality, it is sometimes of very inferior grade, though not necessarily so. If any guaranty regarding its purity can be obtained, it may be used for dip making, in case of necessity, in the same proportions as caustic soda..

THE GENERAL COMPOSITION OF DIPS.

All arsenical cattle dips contain arsenious oxid as the active tick-killing agent. But since straight arsenious oxid, that is, white arsenic, is so slightly and slowly soluble in water, it is necessary to use some other chemical agent, such as sodium carbonate or hydroxid, to bring the arsenious oxid into solution. In this way the white arsenic is changed to sodium arsenite if either sodium hydroxid or sodium carbonate is employed, or to potassium arsenite if the corresponding potassium compounds are used. Starting with a given weight of white arsenic, whether it is converted to sodium arsenite or to potassium arsenite appears to make no difference in the action of the finished dip.

After the white arsenic has been brought into solution, a variety of substances, such as tar, soap, oils, etc., may be added with one or more of the following objects in view: (1) To increase the effectiveness of the bath against ticks, either through greater penetrating power or better adhesion, or through repellent action; (2) to render milder the effect of the bath upon cattle; (3) to denature the bath so that cattle will not drink it. Proprietary concentrated dips differ from each other and from home-made dips essentially only in the nature and amount of such added substances.

MAKING THE BOILED DIP.

The boiled dip has been recommended for use in two strengths, the baths corresponding to which will be termed here "low-strength bath" and "high-strength bath." The low-strength bath is commonly used for ordinary tick-eradication work on the range, the cattle being dipped regularly every two weeks for possibly several months. The high-strength bath is used to treat cattle which are undergoing transportation to a tick-free region, the treatment being usually limited to only two dippings, 5 to 10 days apart.

To make 500[1] gallons low-strength bath provide:

Sal soda[2]	24 pounds.
White arsenic, 99 per cent pure, in fine powder	8 pounds.
Pine tar	1 gallon.

Put 25 gallons of water in a kettle or tank of 40 to 50 gallons capacity, heat to boiling, and add the sal soda. When this has dissolved add the white arsenic, then boil and stir for 15 minutes or longer, until the white arsenic has entirely disappeared. If intended for immediate use cool to 140° F. (by the addition of cold water if desired), then pour in the pine tar in a thin stream while constantly and vigorously stirring the solution. Immediately empty the liquid into the dipping vat, which has already been three-fourths filled with water, and stir thoroughly.

For a stock solution to be kept on hand and used when needed, add no tar, but, after the solution of arsenic and soda has become entirely cold, make it up to 25 gallons (see method on page 7), stir well, let settle, and draw off into containers which can be well closed. This constitutes "low-strength boiled arsenic stock," and its use in a diluted dipping bath calls for a "tar stock," the preparation of which is described on page 7.

High-strength bath or high-strength boiled arsenic stock is prepared in exactly the same way, except that for 500 gallons of diluted bath there is used 10 pounds of white arsenic and 25 pounds of sal soda (or 11 pounds monohydrated sodium carbonate).

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[1] The number of pounds of white arsenic needed to make any number of gallons of bath of any strength may be obtained from Table 1, on page 11.

[2] Or monohydrated sodium carbonate, 10½ pounds.

A by-product of the action of sodium carbonate on white arsenic is the gas carbon dioxid. The escape of this gas is attended by considerable foaming of the solution, so the kettle must be generously large, and the operation of boiling must have constant watching to prevent the liquid from frothing over the edge of the kettle.

The kettle or tank, utensils, and materials must be perfectly free from all greasy or oily substances, since a small quantity of such matter is sufficient to form a coating over the arsenic and thus to prevent or delay its solution.

The boiled dip may be made perfectly well with very hard water, but, in that case, some residue of a fine white or gray powder will be left undissolved after boiling. This residue carries no arsenic, but arises from the action of the sodium carbonate upon compounds, chiefly of lime, in the water. Examination of the liquid after boiling for a few minutes with the soda before the arsenic has been added will show how much residue may be expected from this source.

MAKING THE S-B DIP.[1]

The S–B arsenical dip was developed by the present writer about two years ago to meet certain drawbacks to the boiled dip, namely, (1) the necessity for boiling large amounts of liquid, and (2) the impossibility of preparing highly concentrated stock solutions. Bureau employees in the field have given the preparation a thorough test in practical dipping. The difference between the S–B dip and the boiled dip is merely in the formulas and methods of preparation, the composition of the diluted baths used for dipping being practically the same in both cases.

The S–B dip is prepared in two parts which must not be mixed except in the diluted dipping bath, (1) arsenic stock, (2) tar stock.

S–B arsenic stock requires the following materials ready to hand before starting:

	Pounds.
Caustic soda,[2] at least 85 per cent pure, dry, granulated	4
White arsenic, 99 per cent pure, in fine powder	10
Sal soda,[3] crystals	10

In a 5-gallon kettle or metal[4] pail place the 4 pounds of caustic soda, add 1 gallon of cold water, and stir with a stick until the caustic soda is practically all dissolved. Without delay begin adding the white arsenic, in portions of a pound or two at a time, as fast as it can be dissolved without causing the solution to boil, stirring all the time. If the liquid begins to boil, stop stirring and let it cool slightly before adding more arsenic. The secret of success is to work in the arsenic fast enough to keep the solution very hot—nearly but not

[1] Abbreviated from "self-boiled," the name being suggested by the fact that the heat necessary to prepare the dip is wholly derived from chemical action between the raw materials.

[2] Or 5½ pounds dry caustic potash of equal purity.

[3] Or 4½ pounds monohydrated sodium carbonate.

[4] The chemicals employed have no effect upon iron. They will, however, actively corrode zinc, tin, or solder; hence a soldered pail must be watched for leaks and is far inferior to a seamless pail, stamped from a single sheet of iron. A tinned pail is preferred to a galvanized one, but a plain iron seamless pail or an iron kettle should be obtained if possible.

quite at the boiling point. The result should be a clear solution, except for dirt. If the liquid persistently remains muddy or milky, it may be because the operation has been conducted so fast that much water has been boiled out and sodium arsenite is beginning to crystallize, so add another gallon of water and stir. If the solution does not then clear up, the caustic soda must have been very low grade, and the undissolved substance must be arsenic. In that case, put the kettle over the fire, heat nearly, but not quite, to boiling, and stir. As soon as the solution of arsenic is complete, dilute to about 4 gallons, add the sodium carbonate, and stir until dissolved.

CAUTIONS: It is necessary to avoid splashing. Hence never work hurriedly; stir deliberately and regularly; do not dump in the arsenic and sal soda, but carefully slide them in from a grocer's scoop held close to the side of the pail and to the surface of the liquid. Perform the whole operation in a well-ventilated place and avoid inhaling steam.

After the solution has become cold add water to make it to exactly 5 gallons,[1] mix well, let settle, and draw off into containers which can be tightly corked or otherwise closed. Jugs or demijohns are best, but tin cans will serve if occasionally inspected for leaks which may occur after a time through the action of the solution upon the solder of the can.

Tar stock appropriate for use with either S-B arsenic stock or boiled arsenic stock is prepared thus:

In a capacious metal pail dissolve three-fourths of a pound of dry caustic soda or concentrated lye (or 1 pound of dry caustic potash) in 1 quart of water, add 1 gallon of pine tar, and stir thoroughly with a wooden paddle until the mixture, which at first looks streaked and muddy, brightens to a uniform thick fluid somewhat resembling molasses. Test it by letting about a teaspoonful drip from the paddle into a glass of water (a glass fruit jar or a wide-mouth bottle will serve) and stirring thoroughly with a sliver of wood. It should mix perfectly with the water. Globules of tar which can be seen by looking at the glass from underneath and which can not be blended with the water by repeated stirring indicate that more caustic-soda solution is needed. In that case make up more caustic-soda solution of the same strength and add it, not more than a pint at a time, and with thorough stirring, until the desired effect is produced.

If an appropriate glass vessel for making the test is not at hand, a little of the mixture may be taken between the fingers, then dip the fingers under water and try to rub off the tar. It should leave the fingers perfectly clean after a little rubbing with water. If an oily coating remains, more caustic-soda solution is needed. Such an extra addition of caustic soda will be required only in case of a very low-

[1] Best done by previously determining by measurement the depth of 5 gallons of water in the kettle. Set the kettle exactly level and mark the depth on a stick held vertically on the center of the bottom.

grade chemical or a very highly acid tar. The tar stock should be kept in closed containers, such as a pail with a friction top.

DILUTING THE DIP TO FORM A BATH.

Whatever the dip used, whether boiled dip, S–B dip, or a proprietary preparation,[1] certain facts must be borne in mind and a certain routine followed in preparing baths for dipping. All concentrated arsenical preparations are considerably heavier than water, and unless properly introduced into the dipping vat tend to make their way to the bottom, after which it is difficult to get an even mixture. In preparing a diluted bath it is necessary first to fill the vat with water, leaving just enough space below the full water line for the necessary volume of concentrated dip. Then the desired amount of concentrated dip is to be poured in a thin stream evenly all over the surface of the water—except, of course, at the shallow exit end of the vat—after which a few minutes of brisk stirring will make certain that the bath is of uniform strength throughout. If tar stock is used, as in the case of the S–B dip, the tar stock is to be added before the arsenic stock and may be put in when the vat is about three-fourths filled with water. Tar stock should always be mixed with two or three times its volume of water before being added to the vat.

The dilutions at which the various concentrated stocks will be used are as follows:

Boiled arsenic stock, containing either 8 pounds (low strength) or 10 pounds (high strength) white arsenic in 25 gallons, for the corresponding strength bath, 1 gallon added to every 19 gallons water (2⅛ pints to 5 gallons).

S–B arsenic stock, containing 10 pounds white arsenic in 5 gallons, for low-strength bath 1 gallon added to every 124 gallons water (5⅛ fluid ounces to 5 gallons); for high-strength bath add 1 gallon to every 99 gallons of water (6½ fluid ounces to 5 gallons).

Tar stock, for both low-strength and high-strength baths, 1 gallon added to every 300 gallons of finished bath (2 fluid ounces, or 4 tablespoonfuls, to 5 gallons). Mix the tar stock with two or three times its volume of water before adding to the vat. A certain latitude in the amount of tar stock used is permissible, but it is believed that the above proportions will be found most satisfactory.

REPLENISHING THE BATH AND CORRECTING ITS STRENGTH.

As dipping goes on, the bath will naturally need replenishing. In addition its strength will probably need correction from time to time. The causes which may lead to changes in the strength of arsenical baths, together with methods

[1] It is very likely that the bureau will issue permission for certain proprietary preparations to be used in official dipping. Any such product will bear a statement on the label to the effect that the product has been examined by the bureau and has been permitted for use in official dipping at a given dilution.

of chemical analysis, have been elsewhere discussed by the writer.[1] Here it is sufficient to note that even if all precautions are taken against leakage, either in or out, against evaporation, and against mistakes in measurements, etc., still the bath is likely to change its strength owing to the action of microorganisms which grow therein in spite of the presence of the poisonous arsenic. As already mentioned, the active ingredient of the bath is an arsenite, either of sodium or potassium. One species of microorganism is able to take oxygen from the air and to combine it with the arsenite, thus forming an arsenate, a distinctly different compound of arsenic, and one which is much less poisonous to ticks. This species of microorganism appears to flourish in nearly all dipping baths under ordinary conditions of use and operates to gradually weaken the bath. There is, however, another species of microorganism which occasionally makes itself manifest in baths through which cattle are passed in exceptionally large numbers or at frequent intervals, and which operates in precisely the opposite manner, namely, to reduce any arsenate which may be present to arsenite, thus rendering the bath stronger.

The chemical analysis of arsenical baths with sufficient accuracy for practical purposes is not a difficult matter. It does, however, require some chemical training and equipment. If State officials concerned with dipping can not make provision for the execution of analyses, it should not be difficult to find someone—physician, veterinarian, pharmacist, instructor in school or college, or even a student—who, for a fee, which might be comparatively small if a sufficient number of samples from various sources could be counted on, would find it worth while to undertake this work. It is desirable to have the "actual arsenious oxid"—that is, the amount of arsenic existing as arsenite—determined at least once a month, and the "total arsenious oxid"—that is, the amount of arsenic existing as both arsenite and arsenate—determined at least every two months. To avoid danger of poisoning cattle, it is safer to discard the bath entirely whenever the "total arsenious oxid" would rise above 0.25 per cent for the low-strength bath or above 0.30 per cent for the high-strength bath after the bath had been adjusted to contain the proper amount of "actual arsenious oxid."

In taking samples for analysis certain precautions are necessary. First, the bath must be well stirred; next, the sample is filled at the vat side into the bottle in which it is to be sent to the analyst. The bottle should hold not less than 4 fluid ounces (one-fourth pint) and should be filled up to the neck. Unless the sample can be placed in the hands of the analyst in a very few hours it should be treated with formaldehyde to preserve it from the action of microorganisms which may affect the arsenic and which may work very rapidly in the sample after its removal from a comparatively cool location underground and exposure to hot summer weather. A little concentrated formaldehyde solution (37 per cent) may be cheaply obtained from the druggist, together with a medicine dropper. The formaldehyde is to be carefully added to the sample with the medicine dropper, in the proportion of exactly 5 drops to each 4 ounces of sample (20 drops to a pint). The bottle is then to be immediately corked, the cork and lip of bottle wiped dry and completely covered with melted sealing wax, rosin, or some similar material, in order to exclude air. A few matches will furnish the heat necessary for melting the sealing material. The analyst should be informed of exactly what steps were taken in preparing the samples, and the latter should be shipped to him without delay.

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[1] Department of Agriculture Bulletin 76.

There are two methods of attacking the problems of replenishing a bath and of correcting its strength—(1) method by weight and (2) method by volume.

The method by weight.—This method bases all calculations upon the weight of white arsenic which actually is in the vat and the weight which ought to be in the vat. Table 1[1] gives the weight of white arsenic which is actually present in baths of various volumes and of varying percentages of arsenious oxid.

When the quantity of bath in the vat lies outside the range of the figures given in Table 1 it will only be necessary to multiply or to divide by 2. For example, if the bath amounts to 750 gallons it must evidently hold only half as much arsenic as if it amounted to 1,500 gallons. If, on the other hand, it is desired to more accurately employ figures which lie between those given in the table, either for volúme of bath or for percentage or weight of arsenic, it is only necessary mentally to split the difference between the figures actually given.

The manner in which Table 1 is used may be illustrated as follows:

Suppose one needs to replenish and correct a bath which is contained in a vat holding 1,500 gallons to the full water line. He finds that he has in the vat 1,050 gallons of bath which his analyst informs him contains 0.14 per cent actual arsenious oxid. Looking up these figures in the table, he finds that they indicate 12¼ pounds of arsenious oxid in the vat. What he wants is a vat filled with solution of proper dipping strength, we will say, of the low-strength formula. Now, the low-strength formula calls for 0.19 per cent actual arsenious oxid, and, as before stated, his vat holds 1,500 gallons to the full water line. Looking up these figures in the table, he finds that his vat when filled with solution of proper strength must contain 23¾ pounds of arsenious oxid. Therefore, in filling his vat to the full water line he must introduce 23¾ less 12¼ pounds of white arsenic, or 11½ pounds.

Having found from Table 1 the weight of white arsenic necessary to add to the vat, subsequent procedure depends upon the kind of dip used. In the case of boiled dip prepared on the spot, it is simply necessary to weigh out the proper amount of arsenic and to boil it with the corresponding amount of sodium carbonate, water, etc. In case the low-strength boiled arsenic stock is to be employed, it is necessary to remember that it carries 1 pound of arsenious oxid in every 3⅛ gallons. Therefore, multiply the number of pounds of white arsenic needed by 3⅛ in order to find the number of gallons of low-strength boiled arsenic stock to be added. In case of the S-B arsenic stock, there is present 2 pounds of arsenious oxid in every gallon. Therefore, divide the number of pounds of white arsenic desired by 2 in order to obtain the corresponding number of gallons of S-B arsenic stock.

The high-strength boiled arsenic stock, of course, carries 1 pound of white arsenic in each 2½ gallons.

[1] Credit for this form of table is due to Dr. G. A. Handley, veterinary inspector in this bureau.

TABLE 1.—*Table for finding pounds of white arsenic in vat.*

Liquid in vat.	Per cent actual arsenious oxid in bath.															
	.10	.11	.12	.13	.14	.15	.16	.17	.18	.19 [1]	.20	.21	.22	.23	.24 [2]	.25
Gallons.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1,000.....	8¼	9	10	10¾	11½	12½	13¼	14	15	15¾	16½	17½	18¼	19	20	20¾
1,050.....	8¾	9½	10½	11¼	12¼	13	14	14¾	15¾	16½	17½	18¼	19¼	20	21	21¾
1,100.....	9¼	10	11	12	12¾	13¾	14½	15½	16½	17½	18¼	19¼	20	21	22	22¾
1,150.....	9½	10½	11½	12½	13½	14¼	15¼	16¼	17¼	18¼	19	20	21	22	23	24
1,200.....	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1,250.....	10½	11½	12½	13½	14½	15½	16½	17¾	18¾	19¾	20¾	21¾	22¾	24	25	26
1,300.....	10¾	12	13	14	15	16¼	17¼	18¼	19½	20½	21½	22¾	23¾	24¾	26	27
1,350.....	11¼	12¼	13½	14½	15¾	16¾	18	19	20¼	21¼	22½	23½	24¾	25¾	27	28
1,400.....	11½	12¾	14	15	16¼	17½	18½	19¾	21	22	23¼	24½	25½	26¾	28	29
1,450.....	12	13¼	14½	15½	16¾	18	19¼	20½	21¾	23	24	25¼	26½	27¾	29	30
1,500.....	12½	13¾	15	16¼	17½	18¾	20	21¼	22½	23¾	25	26¼	27½	28¾	30	31¼
1,600.....	13¼	14½	16	17¼	18½	20	21¼	22½	24	25¼	26½	28	29¼	30½	32	33¼
1,700.....	14	15½	17	18¼	19¾	21¼	22½	24	25½	26¾	28¼	29½	31	32½	34	35¼
1,800.....	15	16½	18	19½	21	22½	24	25½	27	28½	30	31½	33	34½	36	37½
1,900.....	15¾	17¼	19	20½	22	23¾	25¼	26¾	28½	30	31½	33	34¾	36¼	38	39½
2,000.....	16½	18¼	20	21½	23¼	25	26½	28¼	30	31½	33¼	34¾	36½	38¼	40	41½

[1] This column may be taken as representing, nearly enough, correct weights of white arsenic for the low-strength bath.
[2] This column represents correct weights of white arsenic for the high-strength bath.

The method by volume.—This method naturally applies only to the use of stock solutions, not to cases where the desired amount of white arsenic is to be weighed out and dissolved on the spot. The facts needed to start on are exactly the same in both methods; that is, one must know the capacity of the vat at the full water line, the amount of bath actually in the vat, and its strength expressed as per cent of actual arsenious oxid. The problem really resolves itself into correcting the strength of the bath already in the vat, for when this has been done it is simply necessary to fill up the remaining space in the vat with bath of the regular strength. Calculations are simplified by the use of Table 2.

TABLE 2.—*Amount of arsenic stock necessary to correct each 100 gallons bath.*

Per cent actual arsenious oxid in bath.	For low-strength bath—		For high-strength bath—	
	Add low-strength boiled arsenic stock.	Add S-B arsenic stock.	Add high-strength boiled arsenic stock.	Add S-B arsenic stock.
Per cent.[1]	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*
0.10	2.45	0.38	(1)	(1)
.11	2.18	.34	(1)	(1)
.12	1.91	.29	2.62	0.50
.13	1.64	.25	2.40	.46
.14	1.36	.21	2.18	.42
.15	1.09	.17	1.96	.38
.16	.82	.13	1.74	.34
.17	.55	.08	1.53	.29
.18	.27	.04	1.31	.25
.19	....	....	1.09	.21
.20	....	....	.87	.17
.21	....	....	.65	.13
.22	....	....	.44	.08
.23	....	....	.22	.04

[1] A bath less than half the desired strength should be discarded entirely.

To show the manner of using Table 2, the same example may be taken as served to illustrate Table 1, namely, a 1,500-gallon vat that contains 1,050 gallons of bath analyzing 0.14 per cent actual arsenious oxid, which is to be brought to the full water line with standard low-strength bath. Suppose that low-strength boiled arsenic stock is to be employed. From Table 2 it will be found that each 100 gallons of 0.14 per cent bath requires 1.36 gallons of low-strength boiled arsenic stock to bring it to the right strength, so for 1,050 gallons there is needed $10\frac{1}{2}\times1.36=14.28$ gallons of stock, which would bring the whole volume to $1,050+14=1,064$ gallons of proper strength bath. There is then left $1,500-1,064=436$ gallons of regular low-strength bath, which must also be introduced to fill the vat, for which there is, of course, needed $464\div20$[1]$=23.2$ gallons of boiled arsenic stock. Now, $14.28+23.2=37.48$, or practically, $37\frac{1}{2}$ gallons of boiled arsenic stock altogether. Therefore water will be run into the vat, about 6 quarts of tar stock being added during the process as called for by the volume of fresh liquid introduced, finally leaving just enough room below the full water line for $37\frac{1}{2}$ gallons of low-strength boiled arsenic stock which is carefully measured in.

It appears not worth while to give a table for reducing baths if they are found by analysis to be too strong. This event but seldom occurs, and if it does the amount of water to be added may be easily calculated. If, for example, a bath analyzes 0.25 per cent actual arsenious oxid and is to be reduced to 0.19 per cent, then each 100 gallons should be diluted to make $100\times\frac{25}{19}=131\frac{1}{2}$ gallons—that is, $31\frac{1}{2}$ gallons of water must be added to each 100 gallons of bath in the vat.

OBTAINING THE CAPACITY OF A VAT.

To obtain the capacity of a dipping vat the following measurements must be taken: (1) Length of the bottom; (2) width of the bottom at its middle point; (3) length of water line; (4) width of water line at its middle point; (5) vertical depth of dip at middle of bottom—that is, at the same point where measurement No. 2 was taken. For future reference it is well to mark this point on the side of the vat. The measurements should be carried to the nearest inch for length, to the nearest half inch for depth, and to the nearest quarter inch for width.

The measurements taken in feet and inches are now to be reduced to feet and decimals of feet through Table 3.

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[1] See page 8.

TABLE 3.—*Equivalents of linear inches and decimals of 1 foot.*

Linear inches.	Decimal of 1 foot.	Linear inches.	Decimal of 1 foot.	Linear inches.	Decimal of 1 foot.
		4	0.33	8	0.67
¼	0.02	4¼	.35	8¼	.69
½	.04	4½	.38	8½	.71
¾	.06	4¾	.40	8¾	.73
1	.08	5	.42	9	.75
1¼	.10	5¼	.44	9¼	.77
1½	.13	5½	.46	9½	.79
1¾	.15	5¾	.48	9¾	.81
2	.17	6	.50	10	.83
2¼	.19	6¼	.52	10¼	.85
2½	.21	6½	.54	10½	.88
2¾	.23	6¾	.56	10¾	.90
3	.25	7	.58	11	.92
3¼	.27	7¼	.60	11¼	.94
3½	.29	7½	.63	11½	.96
3¾	.31	7¾	.65	11¾	.98

There is an old, much-used rule for obtaining the capacity of a dipping vat which, though somewhat inaccurate, possesses the marked advantages of being easily grasped and, therefore, of not being liable to error in its application and of being readily worked out independently if partially forgotten. This approximate rule for present purposes may be stated as follows: *Multiply the average length by the average width, the product by the depth, and this product by 7½.*[1] The average length is of course obtained by adding the bottom length to the water-line length and dividing the sum by 2; the average width is obtained in the same manner.

The rule may be thus expressed as a formula:

$$\frac{\text{top length} + \text{bottom length}}{2} \times \frac{\text{top width} + \text{bottom width}}{2} \times \text{depth} \times 7\tfrac{1}{2} = \text{approximate gallons capacity.}$$

As previously noted, the results given by this rule or formula are not quite accurate. In fact, it does not account for the upper corners of the vat at the exit incline, and so the vat really holds somewhat more dip than thus calculated. The volume of this additional portion of the vat may be easily calculated after the following correction rule: *Multiply half the difference of the lengths by half the difference of the widths, the product by the depth, and this product by 2½.*[2]

Expressed as a formula the correction becomes:

$$\frac{\text{top length} - \text{bottom length}}{2} \times \frac{\text{top width} - \text{bottom width}}{2} \times \text{depth} \times 2\tfrac{1}{2} = \text{additional gallons capacity.}$$

[1] The precise figure is 7.48; that is, the number of gallons in one cubic foot.

[2] That is, by one-third of 7½. Mathematically the correct order is to multiply by one-third the depth, then by 7½. Practically, of course, the result is the same.

This correction, added to the approximate volume first found, gives the true capacity of the vat as nearly as it is possible to calculate it, though if the vat is unevenly constructed, no formula can be entirely accurate.

To illustrate the whole process of calculating the capacity of a vat, we will suppose that a vat has been constructed after the plans and specifications of the bureau elsewhere given. The measurements as taken, and as reduced to decimals through the use of Table 3, are the following:

Vat.	As taken.	Reduced to decimals.
	Ft. in.	*Ft.*
Bottom length	12 0	12.0
Bottom width	1 6	1.5
Water-line length	22 9	22.8
Water-line width	2 $8\frac{1}{2}$	2.71
Depth	5 3	5.25

In reducing to decimals, lengths need be carried only to the nearest tenth, but width and depth should be carried out to hundredths. Throughout subsequent calculations an accuracy greater than 1 per cent is unnecessary, hence decimal places should be cut off when multiplying so that each number multiplied, unless a whole number, shall contain not more than three figures.

Applying the approximate rule:

(1)	(2)	(3)	(4)	(5)
22.8	2.71	17.4	36.7	193
+12.0	+1.50	× 2.11	×5.25	× $7\frac{1}{2}$
2) 34.8	2) 4.21	36.714	192.675	1,448 gallons, approximate capacity.
17.4	2.11			

Applying the correction:

(1)	(2)	(3)	(4)	(5)
22.8	2.71	5.4	3.29	17.3
−12.0	−1.50	× .61	×5.25	× $2\frac{1}{2}$
2) 10.8	2) 1.21	3.294	17.2725	43.3 gallons, correction.
5.4	.61			

The correct figure for the capacity of the vat is, therefore, 1,448+43=1,491 gallons.

CONSTRUCTING A MEASURING ROD FOR THE VAT.

In replenishing or strengthening dipping fluids it is frequently necessary to ascertain just how many gallons of fluid are contained in a partially filled vat. Taking the water-line measurements and then calculating the contents is inconvenient and may sometimes seriously delay dipping operations. Therefore it is desirable to construct a measuring rod which will give directly the number of gallons of liquid in the vat at any time. Of course such a rod may be graduated by measuring successive known volumes of water into the vat and marking on the rod the depth of each known volume, but in many cases graduation through calculation may be more practicable.

The first step is to calculate the water-line measurements at half depth and then at three-quarter depth. A little consideration will show that the water-line measurements at half depth are exactly half-way between the bottom measurements and the water-line measurements of the completely filled vat; that is, they are the average of these two measurements, obtained by adding them together and dividing by two. In the same way the water-line measurements at three-quarter depth are the average of the water-line measurements at half depth and at full depth.

The second step is to calculate the capacity of the vat when filled to three-quarter depth. Then, having prepared a straight, smooth stick, 7 or 8 feet long and about 1½ inches square, lay off from one end (marked "bottom") the feet depth at the three-quarter level, and mark the point with a pencil line, also adding the figure for gallons capacity at that point.

Third, subtract the capacity at three-quarter depth from the capacity at full depth, point back to the left two decimal places in the remainder, and divide it into one-fourth of the actual full depth in feet. The quotient is the average number of feet increase in depth per 100 gallons liquid above the three-quarter level.

Fourth, subtract the actual capacity at the three-quarter level from the next even 100 gallons above that level and set this figure as the numerator of a fraction of which 100 is the denominator. By this fraction multiply the figure for feet per 100 gallons, obtained in the third operation. The product is the distance to be laid off on the rod above the three-quarter depth point to obtain the level of the next even 100 gallons above that point. By referring to Table 3, convert this distance to inches and lay it off on the rod with proper notation. Now, having obtained this point for an even 100 gallons, it is only necessary to continue therefrom, marking off the level of each succeeding 100 gallons by using the figure obtained for "depth per 100 gallons." The same figure can be used to obtain capacities only a short distance below the three-quarter level without serious error. But by a similar series of calculations it is possible to obtain the capacity at half depth, then the true average figure for feet per 100 gallons between half depth and three-quarter depth, and so to graduate the rod between those two levels.

The graduations are to be made permanent by saw cuts or notches, 50-gallon marks being interpolated if desired, and the corresponding figures are cut into the wood.

An example may make the whole operation clearer. Taking the vat already used to illustrate the method of obtaining total capacity (p. 14), we first make the following table of dimensions:

Vat.	At full depth.	At half depth.	At three-quarter depth.
	Feet.	*Feet.*	*Feet.*
Water-line length	22.8	17.4	20.1
Water-line width	2.71	2.11	2.41
Bottom length	12.0	12.0	12.0
Bottom width	1.5	1.5	1.5
Depth	5.25	2.63	3.94

Second, we calculate the capacity at three-quarter depth (3.94 feet) to be 956 gallons. From Table 3, 0.94 foot is found to be equal to 11¼ inches; hence, at 3 feet 11¼ inches from the bottom end of the rod is made the mark for a capacity of 956 gallons.

Third, knowing the full capacity to be 1,491 gallons; 1,491—956=535 gallons, or 5.35 hundreds of gallons space in the vat between the three-quarter and full-depth levels, which corresponds to 5.25÷4=1.31 feet difference in depth; 1.31÷5.35=0.245 foot per 100 gallons.

Fourth, 1,000—956=44 gallons; $\frac{44}{100}\times0.245=0.108$ foot, corresponding to 44 gallons. From Table 3, 0.108 foot=1¼ inches (nearly), so on the rod 1¼ inches above the mark for 956 gallons is made a mark for 1,000 gallons. Then, from the 1,000 gallons mark is measured off 0.245 foot=3 inches for 1,100 gallons; 2×0.245=0.49 foot=6 inches for 1,200 gallons, etc.

The graduations necessarily depart a little, though not much, from the true points for levels between the fixed points established by calculation. One may, if familiar with the process of "plotting," lay off these fixed points from depths on one axis and capacities on the other, and so construct the "curve" of the capacity of the vat.

THE SAFE DISPOSAL OF WASTE ARSENICAL BATHS.

Previous publications of the department have advised that when vats are emptied for cleaning, the waste dip should not be flowed over land or vegetation to which domestic animals have access, or from whence it may find its way into water supplies, but should preferably be run into a properly located pit protected by a fence.

Dalrymple and Kerr[1] have proposed to add slaked lime and copperas to waste dip in the vat in order to throw down arsenic in an insoluble form, thus allowing the overlying liquid, after settling, to be disposed of as if arsenic free. The method requires very thorough stirring in order that the difficultly soluble lime may produce the desired effect. Whether the necessary stirring can be accomplished in large vats with sufficient thoroughness to render the method reliable under practical conditions on a large scale may be questionable.

[1] Bulletin 132, Louisiana Agricultural Experiment Station, 1911. A brief detailed description of the method is given in Farmers' Bulletin 498 and in Bureau of Animal Industry Circular 207 of the U. S. Department of Agriculture.

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FARMERS' BULLETIN

604

Contribution from the Bureau of Statistics (Crop Estimates),
Leon M. Estabrook, Chief.

June 23, 1914.

THE AGRICULTURAL OUTLOOK.

CONTENTS.

GENERAL REVIEW OF CROP CONDITIONS, JUNE 1, 1914.

The composite condition of all crops of the United States on June 1 was about 2.2 per cent above their 10-year average condition on that date. Last year the June 1 condition of all crops was 1.2 per cent below the 10-year average, but prospects declined as the season advanced, the November, or final, reports last year being 6.7 per cent below the 10-year average. Consequently, present conditions are about 9.5 per cent better than the outturn of crops last year.

TIME OF ISSUANCE AND SCOPE OF JULY CROP REPORTS.

The Bureau of Statistics (Crop Estimates), Department of Agriculture, will issue on Wednesday, July 1, at 1 p. m. (eastern time), a report upon the acreage in cotton this year, and the condition of the cotton crop on June 25.

On Wednesday, July 8, at 2.15 p. m. (eastern time), the bureau will issue a summary of the acreage, condition on July 1, and forecast of corn, potatoes, sweet potatoes, rice, flax, and tobacco; the condition and forecast of winter wheat, spring wheat, oats, and barley; the condition of rye, hay, and apples; and the amount of wheat on farms on July 1.

A supplemental report will be issued upon the following crops: The acreage, compared with last year, of sweet potatoes and sorghum; the average weight per fleece of wool; the condition on July 1 of timothy, clover, alfalfa, millet, Kafir corn, pasture, bluegrass for seed, tomatoes, cabbages, onions, beans (dry), lima beans, peaches, grapes, pears, blackberries, raspberries, watermelons, cantaloupes, oranges, lemons, pineapples, limes, grapefruit, hemp, broom corn, sugar cane, sorghum, sugar beets, hops, and peanuts.

Details by States for all crops investigated will be published in the July AGRICULTURAL OUTLOOK.

48538°—Bull. 604—14——1

North Atlantic States.—General crop conditions on June 1 were 102.2 per cent of the average, being 105.0 in Pennsylvania, 103.1 in Rhode Island, 102.9 in New Jersey and Maine, 102.7 in New Hampshire, 102.0 in Massachusetts, 100.6 in New York, 100.3 in Vermont, and 98.7 in Connecticut.

The month of May was generally cold, with light showers during the first half, delaying planting and germination of spring crops. The latter half was favorable, with a tendency toward droughty conditions toward the end, a condition relieved by early June rains. Conditions have been favorable for winter grains. The dry weather toward the close of the month was too late to injure wheat and rye, and the Hessian fly, reported from many sections, will probably do little damage because of the advanced growth and vigorous condition of wheat. The backward, wet spring, delaying farming operations, shortened somewhat the acreage of oats and barley. Although spring grains are short in acreage and a little late, condition generally is fair to good.

Apple trees blossomed very heavily during a period of warm, dry weather, very favorable to activity of bees and other pollenizing insects, except in Pennsylvania, where some wet weather interfered. Insect pests are killing many old orchards in New England, and damage from tent caterpillars was common from Maine to New York. Peach blossoms were largely winterkilled throughout most of the North Atlantic States, and prospects for crop are very poor. Injury to peaches and pears was less severe in New Jersey and Pennsylvania.

Severe winter injured new meadows, but ample moisture, until recently, gave very good condition notwithstanding. Clover condition is fine. Alfalfa is increasingly popular and its cultivation is extending, even into Maine in an experimental way. Pastures have been good until lately.

Vegetables are backward. Berry plants suffered somewhat from winterkill.

South Atlantic States.—General crop conditions on June 1 were about 96.4 per cent of average, being 106.4 in Maryland, 106.1 in West Virginia, 103.9 in Delaware, 98.8 in Georgia, 96.7 in Virginia, 95.9 in Florida, 93.3 in North Carolina, and 91.2 in South Carolina.

The weather has been extremely dry, practically no rain having fallen since early May in the more northerly States of the group, and none since the middle of April in Georgia. Recent rains have occurred in the northern portion of the group, greatly relieving conditions there.

Wheat and other fall-planted cereals have been little injured, but the late-sown grains have suffered and in some counties in the southern States of the group are almost a failure.

The forage crops have been injured from Maryland to North Carolina and are very poor farther south. Late rains in the former States have somewhat improved the situation. Farther south the important hay crop—cowpeas—is not yet planted. Alfalfa is reported fair, though in need of moisture.

Apples show a fine outlook, and a heavy yield is indicated in Maryland and North Carolina, and a good crop in South Carolina and Georgia.

The peach crop promise is excellent, with a bumper crop indicated in West Virginia and a very large one in Georgia.

The pear crop in Maryland, Delaware, and Virginia was injured by late frost, and indicates a light yield. Despite droughty conditions, melons promise an average production in Maryland, but a poorer one farther south.

West Virginia has suffered little from drought, and conditions there are generally reported excellent.

For the date of May 25, the reports are that cotton planting was somewhat delayed by the late spring and subsequently the onset of droughty conditions interfered with the completion of planting and the late-planted seed was in many instances reported as dormant, awaiting rain. The cool nights and extremely dry weather, no rain having fallen for from four to six weeks in most of the area, have resulted in small growth. The plant, while small, appears to be strong and healthy and the dry weather has permitted clean cultivation of the fields. Practically all of the cotton that is up has been chopped; further development waits on needed moisture.

North Central States.—General crop conditions on June 1 were 103.8 per cent of average; being 122.9 in Kansas, 111.3 in Nebraska, 106.5 in Michigan, 105.4 in South Dakota, 104.8 in Wisconsin, 103.6 in Minnesota, 103.5 in Ohio, 103 in Indiana, 100.8 in Iowa, 100 in North Dakota, 92.9 in Illinois, and 92.2 in Missouri.

The cool, wet spring continued into May in the northern tier of States. Ample moisture is reported in the Dakotas, Minnesota, and Wisconsin. Elsewhere the need of rain was beginning to be felt at the close of the month, especially in central and southwestern Ohio, southern Indiana, throughout Illinois and Missouri, and most of Kansas. In these States west of the Mississippi conditions are exceptionally fine, except in Missouri. The cool, moist weather has been extremely beneficial to cereals and forages and the fair weather with occasional showers, in the last half of the month, favorable to farm work and rapid plant germination and growth.

The condition of winter wheat in this grand division is exceptionally good, excluding Illinois and Missouri, where drought and insects have done considerable damage. Throughout the area the crop seems assured and in the southern portion the harvest is now in progress.

The Hessian fly is reported principally in southwestern Ohio, southern Indiana, southern and southwestern Illinois, and throughout Missouri, and extends into southwestern Iowa, southeastern Nebraska and northeastern Kansas. While the damage from this pest is considerable, the condition of the crop in most of the States enumerated continues to range from good to phenomenal, being particularly fine (98 per cent) in Kansas. Chinch bugs and also army worms are reported from southwestern Illinois and from Missouri. These pests, with the lack of moisture in Missouri and southern Illinois last year and the deficiency during the present season, have reduced the crop there to about an average.

Spring-wheat plantings were delayed and the acreage slightly reduced by the cold, wet spring. Some sections in the spring-wheat belt are decreasing the acreage in favor of feed crops to care for the rapidly increasing number of live stock. The coolness was favorable to root development and the fine growing weather of the last half of the month has allowed the plant to develop rapidly to a condition above the average, while the ample ground moisture gives good promise for its future.

Oats were generally seeded late, but have made very satisfactory progress because of the same reasons favoring spring wheat. The shortage of moisture in the southern portion of these States has reduced the condition there. But oats have not suffered so severely as wheat in Missouri and Illinois.

A tendency to decrease barley acreage because of low prices was partly offset by the late spring, which compelled the planting of a quick-maturing crop. Its increase in North Dakota is for stock feed; particularly in sections unfavorable to corn. It has prospered with the other cereals by reason of the favorable growing weather.

Rye is generally late but good.

Apples promise a good crop in the States east of the Mississippi, having blossomed freely. Some injury was suffered in Indiana and Illinois from a late freeze. An unusual crop is promised in Michigan. Conditions west of the river are unfavorable, the vitality of the trees having been greatly reduced by last year's drought. The trees also suffered there from late spring frost. Insect injuries are reported, particularly in Indiana, Illinois, and Missouri.

The peaches do not promise well, being cut short by the late frost; southern Kansas alone reports good prospects.

Hay in the southern portions of Ohio, Indiana, and Illinois has suffered from need of rain. In the northern tier of States it is reported as fine, but in the remaining prairie States and in Missouri it is somewhat thin and weedy because of damage from last year's drought and overpasturing, this being particularly true of the native wild prairie grasses which are the principal dependence for hay in some of these States.

Much new clover was winterkilled in Ohio, Indiana, and Illinois; but in the dairy belt of Michigan, Wisconsin, and Minnesota the new planting did very well and acreage is increasing. Alfalfa acreage is increasing rapidly throughout this grand division. Its condition is generally reported as favorable, except where suffering from lack of rain.

Vegetables are backward, but otherwise give satisfactory promise.

South Central States.—General crop conditions on June 1 were about 98.7 per cent of average, being 108.9 in Mississippi, 104.6 in Alabama and Kentucky, 102.2 in Louisiana, 101.6 in Oklahoma, 99.7 in Arkansas, 97.1 in Tennessee, and 86.5 in Texas.

The States east of the Mississippi have all suffered from dry weather, practically no rain having fallen during May and in many cases since mid-April. West of the river, conditions are reversed, Texas having suffered severely from excessive rains. There is some excess of moisture in northern, and deficiency in southern, Louisiana. In Arkansas, moisture conditions are generally satisfactory, with some excess in the southwest. Southern Oklahoma has had an excess of moisture. The unusual rainfall has been very beneficial in the western portions of Oklahoma and Texas, where a deficiency is the rule. The temperature over the entire South Central division was unusually cold during the first part of the month.

Reports for May 25 state that the cotton plant has not made satisfactory growth in this grand division, partly because of the cold, wet spring. This delayed plantings somewhat east of the Mississippi River; and in some portions west of the river, owing to continued excessive precipitation, perhaps 30 per cent of the intended acreage was still to be planted on May 25. The cool weather of the first half of May has continued to retard the growth of the plant in all sections, and the dry weather east of the river has delayed germination of much of the late-planted seed. The plant in the eastern sections, while small and about 10 days late, appears to be strong and healthy and the stand, while somewhat imperfect in Alabama and Tennessee, is very satisfactory in Mississippi, particularly in the delta lands and the northern portion of the State. West of the river the plant is from two to four weeks late, and from central Texas and Oklahoma to southwestern Arkansas and northwestern Louisiana much replanting has been necessary, owing both to the rotting of seed because of unfavorable weather conditions and to the low vitality of the seed itself, which suffered from adverse conditions at harvest time last year. In this portion of the cotton belt the fields are foul with weeds, involving a vast amount of future work to rescue the crop and necessarily interfering seriously with the completion of planting and the necessary replanting where the crop has been killed out. Should dry weather follow in this belt, the abundant soil moisture may prove an asset of great value in view of the tendency to summer droughts in the States affected.

The last few days of the period (report relating to May 25) in the States west of the Mississippi River were favorable, with warmth and sunshine, and great activity was witnessed in the cotton fields. The conditions in the western portions of Texas and Oklahoma are exceptionally favorable, the unusual moisture being a blessing for those sections.

The wheat crop (report relating to June 1) matured in fine condition east of the Mississippi River in time to escape injury from the dry weather. The crop in Texas is also reported as fine, notwithstanding the excessive rains, and it is an extra fine crop in the northwestern portion of the State. The condition in Oklahoma is reported as almost ideal, with ample rainfall and little insect damage. There are a few reports of rust. Conditions in Arkansas are not so good, some insects being reported and some complaint being made of dryness in the wheat section.

The winter oats east of the Mississippi River are in fair condition, especially the early fall sown, but the spring sowings are poor, owing to dry weather. Similar conditions exist in Arkansas. In Texas the acreage is somewhat reduced by winter killing of the fall-sown crop and the condition is somewhat lowered by excessive moisture. There is some rust. In Oklahoma the condition of oats is generally good, but not equal to that of wheat, and the acreage is restricted by the big wheat and hay acreage in that State.

East of the Mississippi River the hay crop has suffered, although early cuttings were very good. Much of the hay in this section (cowpeas particularly), follow oats and other early crops, and owing to the dry condition of the soil, planting is being delayed. The condition in Arkansas and Louisiana is very good, but in Oklahoma, while the growth is fine, the meadows are very weedy on account of last year's drought. An increase in clover and alfalfa acreage in northern and central Alabama and Mississippi is noted, many farmers having abandoned cotton for these forage crops. Alfalfa in Oklahoma was set back by freezes and the first cutting was poor.

Tree fruits are good to poor, having suffered from late freezes. The dry weather has done little damage. The peach crop, according to the reports, will be very small, except in isolated sections.

Satisfactory crops of early vegetables were secured, but the late crops are suffering from lack of rain east of the Mississippi River and from excessive rain in Texas. In Oklahoma, Arkansas, and Louisiana, vegetables are good, being favored by sufficient moisture in most sections. Berries are generally poor, having suffered from freezes or drought.

The acreage of sugar cane has been very markedly reduced generally in the commercial sugar-producing sections. The condition is poor, owing to cold and dry weather, except in Texas, where the small acreage shows a good condition.

Western States.—General crop conditions on June 1 were about 106 per cent of average, being 114.1 in California, 108.2 in Colorado, 107 in New Mexico, 105.9 in Utah, 104.5 in Nevada, 103.8 in Oregon, 103.4 in Idaho, 103.2 in Wyoming, 102.6 in Arizona, 100.4 in Washington, and 98.9 in Montana.

The Rocky Mountain States have been blessed with an unusual amount of moisture as a result of heavy snows and late winter rains. The weather is frequently mentioned as ideal. The irrigated sections have ample water supplies impounded, and the areas devoted to dry-land crops have exceptional supplies of ground moisture. This condition has resulted in increasing the acreage devoted to dry-land crops. The growing weather has been good, particularly for grains. Fruits and tender plants have been somewhat injured by late frosts.

Winter wheat is generally very good. Some sections of Montana have had dry weather, with some resulting deterioration to the plant, but elsewhere moisture is ample and prospects are for fine and exceptional crops. The spring-wheat acreage is increased, owing to favorable conditions for planting and the advantage of an unusual supply of ground moisture in the dry-land areas. The condition is recorded generally as very good to excellent.

The oat acreage is also increased and the condition is superior for the same reasons. This is true also of barley and rye. The value of barley as a staple feed crop for live stock in the States of high altitude or latitude with a short growing season is being more and more recognized.

The hay crop throughout this grand division is reported as extra good, this applying to both the seeded forage crops—clover and alfalfa—and to the native grasses on the open range. Grass is superabundant. Clover acreage is increasing rapidly in Idaho, Washington, and Oregon, both for forage and seed production.

Colorado promises one of the finest apple crops in the State's history, with like favorable prospects for peaches and pears. Fruit prospects for all the remaining States of this grand division are above average. Some damage has been suffered from late frosts, but this is offset by bumper crop prospects in other sections.

The condition of the hardy vegetables is reported as fine, but the tender plants have suffered generally from frosts.

The condition of sugar beets is almost normal, or 99 per cent.

GENERAL SUMMARY CONDITIONS, BY CROPS.

TABLE 1.—*Condition of the various crops on June 1, expressed in percentages of their 10-year averages (not the normal), on June 1.*

Winter wheat	114.7	Raspberries	103.7	Cabbages	97.5
Apples	110.8	Cantaloupes	102.6	Watermelons	96.6
Alfalfa	108.6	Spring wheat	102.0	Sugar cane	95.5
Sugar beets	106.5	Lima beans	101.7	Clover	95.0
Barley	106.0	Hay (all)	101.5	Cotton	92.4
Hemp	104.8	Oats	101.0		
Pears	104.7	Blackberries	100.5	Average, all	102.2
Rye	104.3	Pasture	99.8		
Peaches	104.2	Onions	98.3		

FLORIDA AND CALIFORNIA CROP REPORT.

TABLE 2.—*Crop conditions in Florida and California.*

Crop.	Florida.				California.			
	Condition June 1—			Condition May 1.	Condition June 1—			Condition May 1.
	1914	1913	1912		1914	1913	1912	
Pineapples	75	90	94	80				
Oranges	82	90	90	95	92	70	90	95
Lemons			90		87	60	88	92
Limes	86	96	85	95				
Grapefruit	84	82	87	96				
Peaches	72	60	80	80	85	65	87	
Pears	70	45	53	55	80	71	89	
Watermelons	76	80	89	85	95	82	91	
Cantaloupes	68	80	83	80	96	84	91	
Apricots					80	60	85	80
Prunes					65	73	88	
Olives					92	87	92	
Almonds					85	55	85	89
Walnuts					86	77	88	
Velvet beans	82							
Cowpeas	78	88	91					
Tomatoes [1]	72	89	82					
Potatoes, yield per acre	85	76	93					
Potatoes, quality	86	90	87					

[1] Production compared with a full crop.

OUTLOOK FOR THE 1914 FOREIGN WHEAT CROP.

In early June prospects for the Northern Hemisphere wheat crop were, excepting a few countries, fully normal. In Asiatic countries immediately north of the equator, notably southern China, British India, and Persia, wheat harvesting was finished. The yield of British India is officially estimated at 313,000,000 bushels, against 358,000,000 bushels in 1913, a decrease of 45,000,000 bushels. Unofficially the Persian crop is put at 14,000,000 bushels, a deficient yield compared with that of the previous year.

In countries along the north coast of Africa, next in harvest succession, prospects as a whole are less promising than a year ago. The Egyptian wheat, though good in general, has been injured in the Province of Menufia by storms and in upper Egypt is reported below average. In the eastern and coast regions of Algeria drought in March did much irreparable damage, but in other regions the plants were widely revived by April rains. Prolonged drought has also seriously affected the small crop of Tunis.

Throughout the Continent of Europe wheat seems in general to have made the progress toward maturity to be expected at this season, notwithstanding wide-spread apprehension at times of deterioration in some countries from lack of sufficient rainfall and unseasonably low temperatures. In the United Kingdom the former fine prospect was reported in late May as well maintained, though cool weather was then retarding growth and rain was needed in some places.

The total area under winter and spring wheat in France on May 1 has been officially returned as 16,045,000 acres, as compared with 16,175,000 acres last year and 16,179,000 in 1912. The month of May was characterized by violent changes of weather, and it is now realized that a satisfactory outcome of the French crop depends upon continuous favorable weather until after harvest.

In Spain, Italy, and Portugal the ripening grain gives general promise of bountiful yields, excepting in southern Italy, Sardinia, and Sicily, where drought is said to have seriously curtailed the output.

The States of north-central and south-central Europe, as a whole, report prospects about normal. In the Scandinavian countries, Germany, and Austria vegetation is somewhat backward, because of dry and cool weather, but no actual damage has resulted. In Hungary, the former discouraging outlook for a full crop shows considerable improvement compared with a month ago, and in Roumania the fears aroused by a prolonged drought have been dissipated by general rains. The Roumanian wheat area has been officially returned at 4,832,000 acres, compared with 4,011,000 acres in 1913 and 5,114,000 in 1912; a fair yield on the present acreage now seems assured. The scant reports from the Balkan States indicate conditions of growth differing in no important respect from those of ordinary years.

A semiofficial report from Russia states that the condition of winter wheat there was "good" in 66, and spring wheat "good" in 65, out of 72 governments. Late in May copious rain fell in nearly all districts; the benefit to crops, which in some places were beginning to show the effects of drought, was inestimable.

The total area under grain in Canada is provisionally returned as follows: Wheat, 11,203,800 acres, or 188,800 acres more than in 1913; oats, 10,811,000 acres, compared with 10,434,000 acres last year; barley, 1,604,000 acres, or 9,000 acres less than a year ago; and rye, 111,070 acres, against 119,300 acres in 1913. The condition of spring wheat June 1 was 93, winter wheat, 79.

PROGRESS OF THE WORLD'S WHEAT HARVEST.

The proportion of the world wheat crop which is harvested each month has been estimated in the Bureau of Statistics (Crop Estimates) to be approximately as follows:

TABLE 3.—*Wheat harvested each month, per cent and millions of bushels.*

Month.	Per cent.	Million bushels.	Month.	Per cent.	Million bushels.
January	5	187	August	25	937
February	1	38	September	2	76
March	3	113	October	(1)	(1)
April	7	262	November	(1)	(1)
May	4	150	December	3	113
June	15	562			
July	35	1,312	Total	100	3,750

1 Less than 1 per cent—practically none.

The proportion of the crop harvested in any month varies from year to year according as the season is early or late, and also as the yield is relatively large or small in the different latitudes. The figures given are merely approximations; the percentages have been applied to the average yearly world production of the past five years, in round numbers, to obtain the quantities harvested.

From the figures shown it appears that the world harvest season begins in December, when operations start in Australia and South America, enlarge in January, and practically end in February. India then commences, and increases in activity through March and April. In April harvesting operations begin in such countries as Persia, Asia Minor, and Mexico. In May activity is lessened, for then the Indian harvest has been about completed and the harvest season is crossing the Mediterranean from north Africa to southern Europe, where harvests do not become general until June. In June, July, and August, about 75 per cent of the crop is harvested, the season progressing steadily northward during these months. By September harvest operations are nearly completed; Scotland, northern Russia and Siberia, and Canada having a little left over from August. Practically no harvesting of wheat is done in October, and very little in November.

TREND OF PRICES OF FARM PRODUCTS.

The level of prices paid producers of the United States for the principal crops increased about 2.1 per cent during May; in the past six years the price level has increased during May 3.5 per cent; thus, the increase this year is less than usual.

Since December 1 the index figure of crop prices has advanced 4.6 per cent; during the same period a year ago the advance was 9.9

per cent, and the average for the past six years has been an advance of 15.0 per cent.

On May 1 the index figure of crop prices was about 14.5 per cent higher than a year ago, but 17.5 per cent lower than two years ago and 0.1 per cent lower than the average of the past six years on June 1.

The level of prices paid to producers of the United States for meat animals decreased 1.4 per cent during the month from April 15 to May 15, which compares with a decrease of 3.7 per cent in the same period a year ago, an increase of 1.5 per cent two years ago, a decrease of 4.5 per cent three years ago, and a decrease of 4.8 per cent four years ago.

From December 15 to May 15 the advance in prices for meat animals has been 6.5 per cent; whereas during the same period a year ago the advance was 10.3 per cent, and two years ago 19.1 per cent, while three years ago there was a decline in price of 10.8 per cent during this period.

On May 15 the average (weighted) price of meat animals—hogs, cattle, sheep, and chickens—was $7.29 per 100 pounds, which is 3.1 per cent higher than the prevailing price a year ago, 14.1 per cent higher than two years ago, 31.7 per cent higher than three years ago, and 1.0 per cent lower than four years ago on May 15.

A tabulation of prices is shown on pages 18–20.

NOTES.

Early in May, 1914, transportation charges on corn from Argentina to Chicago were reported as follows: Ocean freight, Argentina to Montreal, 7½ cents per bushel; transfer at Montreal from ocean vessels to local steamers, 2 cents; freight by water, Montreal to Chicago, 2½ cents, making a total of 12 cents per bushel. The freight rates by water fluctuate with changes in demand and supply of vessels and of available cargo.

The average production of wheat per capita in the United States in 1911–1913 was 7.4 bushels; in 1891–1893 it was 7.8 bushels.

TABLE 4.—*Wheat: Acreage, condition, forecast, and price, June 1, with comparisons.*

State.	Winter wheat. Condition June 1. 1914	Winter wheat. Condition June 1. Ten-year average.	Winter wheat. Condition May 1, 1914.	Winter wheat. Forecast 1914 from condition.	Winter wheat. Five-year average 1909–1913, final estimates.	Spring wheat. Acreage. Per cent of 1913.	Spring wheat. Acreage. Total, 1914.	Spring wheat. Condition June 1. 1914	Spring wheat. Condition June 1. Ten-year average.	Spring wheat. Forecast 1914 from condition.	Spring wheat. Five-year average 1909–1913, final estimates.	All wheat. Price June 1. 1914	All wheat. Price June 1. Five-year average.
	P. c.	*P. c.*	*P. c.*	*Bu.* (000 omitted.)	*Bu.*	*P. c.*	*Acres.*[1]	*P. c.*	*P. c.*	*Bu.* (000 omitted.)	*Bu.*	*Cts.*	*Cts.*
Maine						97	3	97	98	76	77	100	
Vermont						93	1	85	96	22	24	110	122
New York	95	86	95	7,695	6,793							98	107
New Jersey	87	90	93	1,340	1,475							98	111
Pennsylvania	93	89	94	23,183	21,290							97	107
Delaware	94	89	94	1,929	1,817							100	109
Maryland	93	89	94	9,960	9,290							96	109
Virginia	88	89	95	9,391	9,171							100	113
West Virginia	92	87	95	3,126	2,952							100	112
North Carolina	89	88	92	6,308	5,936							111	120
South Carolina	82	82	88	846	760							126	123
Georgia	88	86	90	1,552	1,382							115	128
Ohio	91	78	96	37,848	29,238							92	108
Indiana	90	77	98	42,494	30,668							92	106
Illinois	82	78	97	41,824	33,640							88	101
Michigan	92	78	92	15,931	14,220							93	106
Wisconsin	92	87	89	1,759	1,591	96	99	93	93	1,795	1,719	84	97
Minnesota	89		89		[2] 810	97	4,026	96	93	63,772	59,859	84	98
Iowa	91	88	95	10,810	6,272	96	331	95	94	5,408	5,548	81	93
Missouri	80	81	99	36,706	31,048							86	103
North Dakota						97	7,285	94	94	85,598	90,231	81	95
South Dakota	85		88		[2] 900	95	3,491	98	94	46,185	38,768	81	94
Nebraska	93	82	94	65,349	45,392	98	343	97	88	5,157	3,687	77	90
Kansas	98	72	96	148,029	73,676	115	63	96	76	907	618	81	95
Kentucky	96	83	98	10,370	9,037							98	109
Tennessee	96	86	97	8,644	7,718							101	113
Alabama	88	84	92	365	297							126	119
Mississippi	90	84	90	14	59							92	98
Texas	95	74	90	16,858	8,863							89	107
Oklahoma	100	72	96	41,905	17,224							83	97
Arkansas	91	84	97	1,252	999							91	103
Montana	93	93	96	12,973	7,636	110	429	95	96	10,596	5,618	70	91
Wyoming	95	93	96	1,168	654	110	55	98	97	1,509	1,019	76	101
Colorado	98	87	95	5,133	3,762	105	273	98	93	7,089	5,266	77	94
New Mexico	100		93	1,021	530	104	31	98	89	729	477	96	105
Arizona	93		94	923	642	120		92	92		[3] 48	150	115
Utah	101	92	99	5,698	3,311	105	68	100	96	2,040	1,853	79	93
Nevada	96		97	437	317	118	27	97	97	812	568	101	121
Idaho	99	95	99	10,136	8,600	105	210	98	96	5,762	4,483	71	87
Washington	94	94	98	32,062	24,609	98	1,078	94	94	21,280	22,227	76	92
Oregon	98	93	102	14,995	12,955	101	177	96	92	3,398	3,399	79	92
California	97	76	95	8,113	7,047							97	106
United States	92.7	80.8	95.9	638,147	441,212	97.3	17,990	95.5	93.6	262,135	245,479	84.4	98.6

[1] 000 omitted. [2] 1913 only. [3] Four years.

TABLE 5.—*Oats: Acreage, condition, forecast, and price June 1, with comparisons.*

State.	Oats.							
	Acreage.		Condition June 1.		Forecast 1914 from condition.	Five-year average, 1909–13, final estimates.	Price June 1.	
	Percent of 1913.	Total 1914.	1914	10-year average.			1914	5-year average.
	Per ct.	*Acres.*	*Per ct.*	*Per ct.*	*Bush.* (000 omitted.)	*Bush.* (000 omitted.)	*Cts.*	*Cts.*
Maine	101	141,000	95	96	5,358	5,029	57	60
New Hampshire	100	12,000	96	94	438	430	56	60
Vermont	100	79,000	94	95	3,045	2,869	57	60
Massachusetts	99	9,000	96	94	320	284	54	59
Rhode Island	100	2,000	95	94	61	57	......	61
Connecticut	99	11,000	88	96	329	342	50	56
New York	94	1,198,000	88	92	36,898	39,681	49	54
New Jersey	96	67,000	84	89	1,913	1,990	49	55
Pennsylvania	93	1,073,000	84	89	31,546	34,464	48	54
Delaware	97	4,000	84	87	118	119	46	53
Maryland	96	43,000	83	86	1,160	1,285	53	54
Virginia	98	191,000	73	84	3,416	3,839	55	59
West Virginia	96	110,000	81	87	2,450	2,558	57	60
North Carolina	100	230,000	76	86	3,671	3,740	63	67
South Carolina	102	367,000	74	83	6,925	7,053	66	69
Georgia	102	428,000	73	87	7,186	7,810	65	69
Florida	90	45,000	67	80	603	701	62	72
Ohio	94	1,692,000	76	87	51,437	65,129	40	46
Indiana	96	1,632,000	80	85	47,002	54,666	39	43
Illinois	99	4,331,000	80	86	138,592	144,625	38	43
Michigan	101	1,515,000	92	87	50,177	47,021	42	47
Wisconsin	102	2,320,000	97	93	85,515	74,644	37	44
Minnesota	102	3,040,000	96	93	105,062	96,426	33	39
Iowa	101	4,929,000	97	93	172,121	166,676	35	39
Missouri	98	1,225,000	71	79	27,832	29,307	46	46
North Dakota	103	2,318,000	93	94	66,828	57,063	33	41
South Dakota	101	1,606,000	99	93	49,288	37,027	34	40
Nebraska	99	2,228,000	97	88	64,835	54,828	38	40
Kansas	102	1,795,000	92	73	56,148	39,612	46	48
Kentucky	96	154,000	77	83	3,083	3,422	56	57
Tennessee	98	294,000	76	86	5,698	6,126	57	58
Alabama	108	351,000	86	87	6,641	5,157	64	67
Mississippi	106	148,000	86	86	2,864	2,146	60	66
Louisiana	108	49,000	91	87	1,092	746	56	62
Texas	98	980,000	85	78	32,487	22,651	49	57
Oklahoma	103	1,061,000	90	71	33,422	18,467	47	52
Arkansas	101	242,000	85	83	5,657	4,569	52	61
Montana	106	530,000	94	96	23,914	18,878	38	53
Wyoming	110	242,000	99	97	8,984	6,399	43	56
Colorado	103	314,000	98	93	12,924	10,397	51	57
New Mexico	102	51,000	96	89	1,812	1,415	53	61
Arizona	110	8,000	96	91	346	242	80	70
Utah	103	93,000	100	96	4,464	3,825	45	60
Nevada	110	12,000	96	97	518	376	64	65
Idaho	102	332,000	98	96	15,292	14,061	35	51
Washington	99	297,000	97	96	14,404	13,493	39	54
Oregon	101	364,000	97	95	13,417	12,906	38	52
California	105	220,000	99	84	8,930	6,624	45	61
United States	100.0	38,383,000	89.5	88.6	1,216,223	1,131,175	40.0	45.3

TABLE 6.—*Barley: Acreage, condition, forecast, and price June 1, with comparisons.*

State.	Barley. Acreage. Percent of 1913.	Acreage. Total 1914.	Condition June 1. 1914	Condition June 1. 10-year average.	Forecast 1914 from condition.	Five-year average, 1909-13, final estimates.	Price June 1. 1914	Price June 1. 5-year average.
	Per ct.	*Acres.*	*Per ct.*	*Per ct.*	*Bush.* (000 omitted.)	*Bush.* (000 omitted.)	*Cts.*	*Cts.*
Maine	100	5,000	95	96	142	118	82	93
New Hampshire	98	1,000	95	92	27	25	95	88
Vermont	100	12,000	95	95	376	372	80	89
New York	93	75,000	89	91	1,936	2,081	70	83
Pennsylvania	95	7,000	91	89	182	179	70	71
Maryland	98	5,000	91	91	146	121	65	......
Virginia	101	11,000	90	91	297	263	74	73
Ohio	98	39,000	88	88	1,064	664	58	72
Indiana	105	8,000	90	86	220	242	54	68
Illinois	101	55,000	95	93	1,620	1,603	57	67
Michigan	102	87,000	93	88	2,306	2,216	61	73
Wisconsin	96	696,000	96	93	20,045	21,351	52	74
Minnesota	95	1,378,000	96	93	35,718	34,044	43	67
Iowa	96	384,000	96	94	10,322	12,394	52	67
Missouri	100	5,000	89	87	120	140	......	81
North Dakota	104	1,326,000	92	93	28,058	22,700	38	59
South Dakota	94	901,000	97	93	20,975	17,368	45	65
Nebraska	103	113,000	98	89	2,713	1,981	51	57
Kansas	100	240,000	87	74	4,802	2,921	55	62
Kentucky	105	3,000	94	86	82	76	80	77
Tennessee	100	2,000	92	86	52	62	70	84
Texas	109	8,000	92	86	221	127	73	82
Oklahoma	105	7,000	98	73	206	156	......	61
Montana	110	66,000	96	95	2,281	1,189	48	72
Wyoming	107	14,000	98	97	453	327	72	75
Colorado	103	103,000	98	92	3,836	2,530	61	71
New Mexico	108	4,000	98	91	133	65	45	69
Arizona	98	37,000	95	92	1,441	1,294	......	83
Utah	105	32,000	99	97	1,331	1,006	55	68
Nevada	105	13,000	99	96	528	467	93	91
Idaho	103	185,000	99	96	7,875	5,905	55	67
Washington	101	182,000	95	95	7,262	6,522	51	67
Oregon	102	122,000	97	94	4,319	3,673	61	71
California	110	1,402,000	98	81	45,341	37,690	54	75
United States	100.4	7,528,000	95.5	90.1	206,430	181,881	49.1	68.1

TABLE 7.—*Hay, pasture, and rye: Condition June 1, with comparisons; price of hay and rye, and acreage of clover in percentage of last year.*

State.	Hay (all tame). Condition June 1. 1914	Hay (all tame). Condition June 1. 6-year average.	Hay (all tame). Condition May 1, 1914.	Clover. Acreage, per cent of 1913.	Clover. Condition June 1. 1914	Clover. Condition June 1. 10-year average.	Alfalfa. Condition June 1. 1914	Alfalfa. Condition June 1. 8-year average.	Pasture. Condition June 1. 1914	Pasture. Condition June 1. 10-year average.	Hay (all). Price June 1. 1914	Hay (all). Price June 1. 5-year average.	Rye. Condition June 1. 1914	Rye. Condition June 1. 10-year average.	Rye. Price June 1. 1914	Rye. Price June 1. 5-year average.
	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	Dols.	Dols.	P. c.	P. c.	Cts.	Cts.
Me.	99	96	93	110	99	96	.....	.....	94	94	13.60	15.16	.....	.....	.....	.....
N. H.	97	94	91	108	98	94	.....	.....	95	94	16.80	16.92	.....	.....	93	.....
Vt.	96	96	95	100	98	95	.....	.....	94	96	15.00	14.60	93	93	71	.....
Mass.	94	93	89	102	92	92	.....	.....	95	92	21.20	19.82	97	93	95	88
R. I.	95	92	94	.....	94	93	.....	.....	94	92	21.20	23.28	.....	.....	.....	.....
Conn.	92	92	92	98	82	93	.....	.....	94	93	20.10	21.38	93	95	92	87
N. Y.	91	90	88	98	89	91	93	92	94	92	15.20	15.88	91	88	72	84
N. J.	85	84	90	100	84	84	93	88	88	88	18.60	20.22	94	94	75	80
Pa.	90	85	89	101	91	86	93	90	92	88	14.80	16.72	95	92	77	82
Del.	81	80	86	103	85	82	88	87	82	84	13.00	18.30	94	90	74	74
Md.	83	78	87	102	86	79	90	86	84	82	15.40	17.42	94	91	71	78
Va.	68	78	88	104	70	80	85	86	70	84	15.50	16.56	90	90	86	84
W. Va.	82	81	92	100	83	86	88	90	82	87	16.80	16.16	92	91	82	87
N. C.	75	86	87	102	78	87	84	87	74	88	17.90	16.68	89	92	96	101
S. C.	73	85	85	105	82	87	81	89	68	87	18.40	19.20	87	87	200	160
Ga.	69	86	86	100	75	89	78	90	68	88	18.20	19.00	85	89	121	143
Fla.	70	86	84	.....	.....	.....	.....	.....	71	86	18.30	17.38	.....	.....	.....	.....
Ohio.	86	82	92	97	86	83	92	86	90	89	12.80	14.70	93	86	68	80
Ind.	82	84	91	88	80	83	90	86	89	89	13.50	13.86	92	86	63	75
Ill.	70	84	88	76	68	85	89	87	75	89	14.20	13.42	91	89	64	77
Mich.	89	87	85	96	89	88	93	88	93	89	12.60	14.38	93	87	63	74
Wis.	97	91	91	101	97	91	93	90	98	91	10.60	13.06	94	91	56	74
Minn.	95	90	89	104	95	91	97	91	96	91	7.40	8.04	93	90	52	70
Iowa.	87	90	91	97	90	90	95	92	92	92	10.40	9.98	95	93	64	73
Mo.	65	82	88	78	65	84	85	87	70	86	15.30	10.86	92	88	75	81
N. Dak.	93	90	86	105	95	89	97	92	94	90	6.50	7.02	91	93	50	67
S. Dak.	99	90	90	101	98	92	101	92	99	92	7.10	7.36	96	93	58	68
Nebr.	98	89	93	96	94	90	105	91	96	88	8.00	8.66	98	89	60	67
Kans.	92	84	85	82	82	85	96	84	86	86	11.10	8.36	98	80	70	76
Ky.	75	83	93	89	80	84	90	88	82	87	17.80	15.64	94	87	83	89
Tenn.	70	84	93	90	74	87	87	89	75	90	18.30	15.72	93	88	93	95
Ala.	74	88	88	105	80	91	92	90	78	91	16.40	15.24	79	88	126	116
Miss.	82	87	89	107	86	89	89	90	84	90	13.80	12.60	.....	.....	.....	.....
La.	90	89	90	110	90	93	91	90	92	93	12.40	11.48	.....	.....	.....	.....
Tex.	95	84	94	110	97	89	95	86	99	90	12.30	11.34	86	79	95	101
Okla.	89	84	86	100	90	85	91	87	87	88	10.60	8.12	100	79	75	78
Ark.	85	85	91	100	87	88	89	89	89	92	14.20	12.58	91	87	80	89
Mont.	96	97	93	105	100	96	98	96	98	96	7.70	10.46	98	96	66	76
Wyo.	102	98	98	105	102	96	102	97	104	99	8.10	10.54	97	96	70	78
Colo.	100	92	96	100	97	93	103	91	101	93	10.10	11.92	99	92	62	74
N. Mex.	93	88	94	108	98	95	95	90	96	85	13.00	11.48	.....	.....	.....	.....
Ariz.	95	92	100	.....	78	94	96	93	90	88	12.50	11.90	.....	.....	.....	.....
Utah.	97	92	98	104	101	95	95	89	101	94	9.20	10.56	102	96	75	72
Nev.	100	96	97	102	99	98	99	95	101	96	8.00	11.70	.....	.....	.....	.....
Idaho.	99	95	98	115	100	97	99	94	98	98	8.00	9.22	98	97	67	76
Wash.	96	95	99	102	98	97	99	96	97	96	12.30	13.96	97	96	70	92
Oreg.	97	94	99	108	99	96	95	94	98	96	9.50	10.86	99	94	83	96
Cal.	98	89	100	124	101	91	100	93	104	88	8.80	11.88	101	84	95	86
U. S.	88.7	87.4	90.9	90.4	81.4	85.7	98.9	91.1	89.8	90.0	12.34	12.90	93.6	89.7	64.4	76.8

TABLE 8.—*Apples, peaches, pears, and berries: Condition June 1, with comparisons and prices of apples.*

State.	Apples.				Peaches.		Pears.		Blackberries.		Raspberries.	
	Condition June 1.		Price May 15.		Condition June 1.		Condition June 1.		Condition June 1.		Condition June 1.	
	1914	10-year average.	1914	4-year average.	1914	10-year average.	1914	6-year average.	1914	8-year average.	1914	8-year average.
	P. ct.	*P. ct.*	*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Maine	98	91	130	100	......	......	94	91	91	92	91	91
New Hampshire	86	86	140	124	15	68	80	86	87	92	86	90
Vermont	95	88	......	103	......	......	88	88	90	90	88	89
Massachusetts	92	86	175	125	25	68	82	83	90	90	90	89
Rhode Island	90	87	......	165	43	69	85	84	87	92	87	89
Connecticut	78	87	145	......	45	69	78	87	93	95	91	91
New York	88	84	140	106	20	63	73	80	87	91	88	90
New Jersey	88	72	130	93	85	64	83	67	90	88	90	86
Pennsylvania	86	72	125	97	60	58	76	65	88	88	90	87
Delaware	84	69	175	......	70	59	80	53	78	87	84	81
Maryland	80	66	......	102	72	59	69	58	88	88	89	85
Virginia	70	58	150	104	67	52	60	51	85	91	82	87
West Virginia	80	58	200	119	73	53	60	48	91	91	91	86
North Carolina	78	59	120	118	83	56	73	54	90	93	88	89
South Carolina	68	60	200	......	77	65	68	60	78	89	75	83
Georgia	70	58	170	184	80	66	60	56	78	91	76	90
Florida	......	......	......	......	72	73	70	57	......	......	......	......
Ohio	71	59	175	110	59	48	65	56	87	87	87	85
Indiana	56	61	130	128	62	54	61	57	89	88	86	85
Illinois	50	58	124	132	68	49	62	50	81	86	81	83
Michigan	84	76	100	84	52	61	80	73	90	86	90	86
Wisconsin	79	78	140	120	......	......	85	71	96	85	94	84
Minnesota	73	78	......	169	......	......	......	......	92	83	89	84
Iowa	53	66	160	138	75	37	70	49	90	82	87	78
Missouri	69	56	160	120	67	46	60	43	86	82	83	78
North Dakota	......	......	......	......	......	......	......	......	......	......	......	......
South Dakota	79	80	200	196	......	......	......	......	......	......	87	84
Nebraska	70	67	240	126	50	42	62	48	80	80	80	78
Kansas	60	60	190	142	70	48	70	50	81	81	80	77
Kentucky	73	59	160	162	78	54	68	52	95	90	91	85
Tennessee	71	54	165	164	68	53	52	46	90	94	86	86
Alabama	65	58	......	......	58	62	47	52	86	92	85	86
Mississippi	58	56	125	95	61	64	60	53	88	90	85	86
Louisiana	60	60	100	......	52	64	55	59	90	89	85	80
Texas	62	69	155	165	31	62	50	61	84	82	80	80
Oklahoma	60	66	190	151	20	62	30	56	79	82	76	76
Arkansas	77	63	180	144	55	65	55	50	90	89	89	84
Montana	95	90	100	142	......	......	95	86	94	......	97	90
Wyoming	98	84	275	......	......	......	......	......	......	......	97	......
Colorado	97	75	150	160	90	50	95	58	98	83	98	84
New Mexico	87	67	230	......	75	54	83	62	91	......	92	......
Arizona	75	65	310	......	81	63	79	74	88	......	85	......
Utah	98	79	120	118	98	66	89	70	96	90	97	89
Nevada	80	66	210	......	90	55	90	......	100	......	97	......
Idaho	85	88	110	128	73	58	80	80	97	92	98	93
Washington	88	89	130	115	65	71	83	87	94	95	95	95
Oregon	86	84	175	122	76	68	75	80	96	96	96	94
California	81	81	140	125	85	76	80	79	95	94	94	94
United States	73.7	66.5	146.4	122.5	61.7	59.2	68.4	65.3	87.5	87.1	89.0	85.8

TABLE 9.—*Melons, cabbages, onions, beans, beets, peas: Condition June 1, with comparisons.*

State.	Watermelons.		Cantaloupes.		Cabbages.		Onions.		Lima beans.		Canadian peas.		Sugar beets.	
	1914	8-year average.	1914	8-year average.	1914	8-year average.	1914	8-year average.	1914	8-year average.	1914	8-year average.	1914	8-year average.
	P.c.	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*
Maine	94	.....	94	.....	91	95	92	91	98	93	97	96	.....	.....
New Hampshire	80	.....	85	.....	91	93	88	92	89	93	97	.....	.....	.....
Vermont	75	.....	70	80	91	94	92	90	100	94	99	95	.....	.....
Massachusetts	95	.....	92	86	90	88	88	90	95	87	95	.....	.....	.....
Rhode Island	80	.....	85	91	94	91	94	90	90	82	100	.....	.....	.....
Connecticut	85	.....	88	87	88	94	89	90	90	90	94	.....	.....	.....
New York	80	82	88	85	89	90	85	89	88	89	90	92	.....	.....
New Jersey	82	79	80	80	83	85	90	88	83	81	91	.....	.....	.....
Pennsylvania	85	77	85	80	87	85	91	90	88	83	91	.....	.....	.....
Delaware	84	79	81	78	89	88	89	88	76	80	92	80	.....	.....
Maryland	78	78	80	78	86	84	91	90	86	78	75	77	.....	.....
Virginia	74	78	75	78	78	87	83	91	78	84	70	.....	.....	.....
West Virginia	78	78	79	78	84	86	88	91	86	85	92	86	.....	.....
North Carolina	74	81	74	81	75	88	82	92	76	86	75	85	.....	.....
South Carolina	74	78	72	78	70	85	74	88	67	83	75	82	.....	.....
Georgia	70	82	68	80	69	88	76	89	69	88	69	.....	.....	.....
Florida	76	83	68	79	82	90	.....	.....	.....	.....	.....	.....	.....	.....
Ohio	80	79	84	80	84	86	88	90	86	85	80	.....	85	86
Indiana	80	88	80	79	83	86	85	88	82	82	85	84	85	.....
Illinois	81	80	80	80	78	86	82	91	77	84	82	88	95	90
Michigan	90	83	91	83	93	86	92	86	91	85	95	89	91	86
Wisconsin	88	84	92	84	93	89	93	90	88	88	95	94	89	91
Minnesota	92	82	93	83	91	88	93	90	100	89	98	90	90	89
Iowa	90	85	90	86	92	91	94	94	91	88	92	89	96	92
Missouri	79	76	85	77	79	82	84	87	84	85	85	81	.....	.....
North Dakota	90	.....	87	.....	90	87	92	91	83	.....	98	.....	.....	.....
South Dakota	93	.....	93	87	92	88	96	91	100	.....	92	.....	.....	.....
Nebraska	89	84	87	83	94	87	96	89	93	85	.....	.....	97	90
Kansas	86	79	87	79	85	82	93	87	91	85	90	.....	90	90
Kentucky	78	80	80	78	85	87	89	92	83	85	80	82	.....	.....
Tennessee	73	81	74	80	79	89	86	93	75	87	82	.....	.....	.....
Alabama	79	81	75	80	77	87	83	92	72	88	79	.....	.....	.....
Mississippi	79	77	77	75	77	85	85	90	82	86	76	.....	.....	.....
Louisiana	82	78	82	78	86	83	87	87	89	87	85	86	.....	.....
Texas	75	78	74	78	82	80	86	85	86	81	85	79	.....	.....
Oklahoma	73	78	74	78	86	80	93	87	91	79	90	.....	.....	.....
Arkansas	79	75	79	75	84	82	91	90	87	83	86	.....	.....	.....
Montana	94	88	94	84	95	94	96	92	98	.....	97	99	95	95
Wyoming	91	.....	95	.....	95	94	98	95	94	.....	103	.....	96	94
Colorado	90	87	93	88	94	89	96	92	97	90	97	94	97	91
New Mexico	86	83	86	84	91	86	90	91	85	.....	92	86	90	88
Arizona	91	90	89	90	86	90	90	94	90	.....	.....	.....	.....	93
Utah	95	84	95	82	97	91	99	94	98	92	102	.....	99	91
Nevada	98	.....	100	.....	98	95	98	94	94	.....	.....	.....	95	.....
Idaho	94	89	90	90	98	95	97	95	98	96	100	95	96	93
Washington	89	88	93	87	91	92	91	92	97	90	94	96	90	95
Oregon	90	88	94	88	94	93	94	93	98	90	97	93	100	94
California	95	88	96	89	96	91	96	92	98	93	92	89	99	91
United States	77.9	79.7	82.1	80.0	86.5	86.8	88.2	89.7	84.8	84.4	.....	.....	95.3	89.5

TABLE 10.—*Prices to producers of agricultural products, June 1.*[1]

[Prices for wheat are given on page 12, oats on page 13, barley on page 14, hay and rye on page 15.]

State.	Corn.		Potatoes.		Buckwheat.		Flaxseed.		Cotton.		Butter.		Eggs.		Chickens.	
	1914	5-year average.	1914	5-year average.	1914	5-year average.	1914	5-year average.	1914	5-year average.	1914	5-year average.	1914	5-year average.	1914	5-year average.
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Maine	84	79	60	70	61	81					29	29	22	21	14.4	15.1
New Hampshire	82	78	82	82		76					30	29	24	22	14.7	14.6
Vermont	78	76	72	77	89	89					27	29	22	20	14.0	13.1
Massachusetts	85	80	96	96	95	88					33	32	26	27	17.4	16.9
Rhode Island	95	96	103	98							32	33	25	26	18.0	17.2
Connecticut	75	78	100	93	80	93					34	33	26	25	16.5	16.0
New York	81	75	81	72	85	77					27	28	21	20	15.7	14.8
New Jersey	80	77	84	89	89	84					31	32	23	23	17.6	17.4
Pennsylvania	77	74	87	78	75	73					26	27	19	19	14.8	13.4
Delaware	79	74	90	88	70	79					27	25	20	19	15.0	14.7
Maryland	77	75	77	80	80	85					25	25	18	18	16.5	14.9
Virginia	89	84	81	84	89	82			13.0	12.3	23	23	17	17	14.9	14.2
West Virginia	89	84	94	87	84	79					23	22	18	17	12.8	11.9
North Carolina	97	94	92	97	87	86			13.0	12.4	23	23	17	16	12.9	11.9
South Carolina	101	99	136	131					13.1	12.6	26	25	20	18	13.5	11.9
Georgia	98	97	119	121					13.3	12.6	25	23	18	18	14.0	13.1
Florida	88	94	126	121					15.0	16.3	33	32	21	21	15.4	13.8
Ohio	70	66	86	76	77	79					22	22	18	18	13.0	11.9
Indiana	67	62	88	78	68	79					21	21	17	17	12.0	11.8
Illinois	68	61	92	89	100	95					23	23	17	17	12.5	11.2
Michigan	67	66	60	57	71	74					22	23	18	18	12.9	11.2
Wisconsin	62	61	53	55	70	76	148	179			25	25	17	17	12.5	11.4
Minnesota	55	54	53	61	74	74	139	178			24	25	16	16	10.6	9.8
Iowa	63	56	89	76	75	90	120	171			24	23	16	16	10.8	9.9
Missouri	78	66	105	95		98	120	150	12.0	10.9	20	20	16	15	12.0	10.8
North Dakota	60	63	61	72			137	181			20	22	14	15	10.2	9.7
South Dakota	59	55	70	82			135	178			22	22	16	15	9.4	8.7
Nebraska	67	56	92	89				153			20	20	15	15	10.1	9.4
Kansas	77	62	99	111			116	164			20	21	15	15	10.6	9.5
Kentucky	87	76	109	100							20	20	16	15	11.8	11.2
Tennessee	88	79	109	97	80	80			12.6	12.1	18	18	15	14	12.4	11.5
Alabama	96	92	109	112					12.9	12.4	21	20	16	15	13.0	11.6
Mississippi	88	90	100	111					12.5	12.4	22	21	16	15	13.0	11.9
Louisiana	87	83	101	96					11.9	12.3	29	26	18	16	12.9	13.0
Texas	91	82	115	104					11.6	12.0	21	20	14	14	10.4	9.2
Oklahoma	79	67	115	121					11.2	11.4	20	20	14	14	10.0	9.3
Arkansas	88	83	113	106					11.8	12.0	22	21	15	15	11.2	9.9
Montana		102	65	88			139	193			30	31	19	23	14.0	14.5
Wyoming	95	68	67	104			125				28	29	21	22	12.0	14.4
Colorado	71	71	59	80			122				25	27	19	20	13.0	12.6
New Mexico	82	96	134	119							35	32	26	22	15.0	12.7
Arizona	130	116	135	126							34	34	25	28	18.7	16.6
Utah	68	83	63	81							28	29	19	18	13.2	12.8
Nevada			55	105							32	34	28	29	19.3	21.6
Idaho	80	92	51	75							26	27	18	21	11.2	12.0
Washington	76	93	46	78							26	28	20	22	14.6	14.1
Oregon	70	93	40	81							28	29	19	21	14.1	12.6
California	89	93	60	102							26	28	22	21	15.6	14.4
United States	75.0	67.9	71.3	74.7	79.0	76.6	136.8	179.7	12.4	12.3	22.8	23.4	17.3	17.0	12.5	11.5

[1] Corn, potatoes, buckwheat, and flaxseed in cents per bushel; cotton, butter, chickens, cents per pound; eggs, cents per dozen.

TABLE 11.—*Prices paid to producers of agricultural products May 15.*[1]

State.	Hogs. 1914	Hogs. 4-year average.	Beef cattle. 1914	Beef cattle. 4-year average.	Veal calves. 1914	Veal calves. 4-year average.	Sheep. 1914	Sheep. 4-year average.	Wool. 1914	Wool. 4-year average.	Milch cows. 1914	Milch cows. 4-year average.	Horses. 1914	Horses. 4-year average.
	Dols.	*Dols.*	*Dols.*	*Dols.*	*Dols.*	*Dols.*	*Dols.*	*Dols.*	*Cts.*	*Cts.*	*Dols.*	*Dols.*	*Dols.*	*Dols.*
Me.	7.80	7.75	6.90	7.48	7.80	7.42	5.00	4.70	19	22	57.00	50.30	225	198
N. H.	9.30	7.90	7.20	6.58	8.90	7.58	5.00	5.03	20	22	58.00	54.30	172	175
Vt.	7.70	7.10	5.40	5.12	7.10	6.40	4.20	4.40	20	21	58.50	48.78	190	163
Mass.	8.40	7.83	7.10	......	9.00	8.33	......	......	20	......	70.00	......	246	......
R. I.	9.80	8.07	7.00	......	10.00	......	5.20	......	18	......	75.00	......	......	......
Conn.	10.00	8.67	8.00	8.73	9.60	9.33	6.00	......	20	......	70.00	60.67	200	217
N. Y.	8.60	7.48	6.00	5.55	8.40	7.10	4.10	4.38	19	20	62.50	54.02	175	178
N. J.	8.50	8.75	7.00	6.08	9.80	8.02	4.80	4.77	20	19	75.00	57.98	180	192
Pa.	8.30	7.85	7.30	6.42	8.80	7.48	5.40	5.08	20	22	62.40	49.68	180	179
Del.	8.50	7.70	6.50	5.63	9.70	8.47	5.10	5.30	20	......	54.20	45.83	135	155
Md.	8.40	7.50	7.50	5.65	9.10	8.25	5.00	4.95	21	21	60.00	38.72	150	145
Va.	7.90	7.20	6.40	5.28	8.20	7.00	4.50	4.45	20	22	48.40	38.78	147	146
W. Va.	7.90	7.40	6.60	5.32	8.00	6.38	4.50	4.50	21	22	59.00	41.08	150	144
N. C.	7.50	7.40	5.20	4.25	6.00	4.88	4.00	4.30	20	22	39.60	33.30	160	149
S. C.	7.30	7.65	4.70	4.15	5.30	5.00	4.90	5.20	16	18	41.40	36.15	170	178
Ga.	7.70	7.32	4.70	4.20	5.50	4.75	4.40	4.72	19	24	37.90	34.10	156	160
Fla.	7.00	6.98	5.00	4.72	6.60	5.63	5.20	4.27	19	20	43.80	37.82	146	150
Ohio	8.00	7.50	7.10	5.98	8.20	6.88	4.50	4.52	21	20	63.20	49.65	164	172
Ind.	8.00	7.42	7.00	5.50	7.70	6.42	4.40	4.40	20	20	57.20	46.32	147	158
Ill.	7.80	7.32	7.10	5.75	8.20	6.52	4.70	4.72	18	20	64.70	51.70	149	154
Mich.	7.80	7.42	6.50	5.45	7.90	6.68	4.60	4.75	21	20	60.70	46.25	174	172
Wis.	7.90	7.28	6.00	4.85	7.80	6.25	5.10	4.70	19	19	70.00	49.48	180	166
Minn.	7.70	7.02	6.20	4.78	7.40	6.00	4.60	4.52	17	18	60.60	44.55	155	166
Iowa.	7.80	7.20	7.30	6.02	7.80	6.15	4.80	4.90	18	17	63.40	49.95	155	165
Mo.	7.60	7.02	6.90	5.58	7.70	6.08	4.60	4.72	19	20	60.00	47.12	124	129
N. Dak.	7.10	6.98	5.90	4.65	7.40	5.85	4.90	4.82	16	17	64.60	47.08	138	164
S. Dak.	7.50	7.05	6.70	5.45	7.60	6.00	5.00	4.92	16	18	67.70	47.18	125	146
Nebr.	7.60	7.08	7.00	5.95	8.00	6.52	5.70	5.55	16	15	67.50	48.40	126	134
Kans.	7.70	7.12	7.10	5.82	7.90	6.35	5.30	5.28	16	16	62.70	49.52	120	134
Ky.	7.50	7.02	6.30	4.85	7.30	6.05	4.00	3.90	21	22	52.50	40.78	126	134
Tenn.	7.30	6.75	5.70	4.45	6.30	5.32	4.00	3.88	18	21	48.20	37.92	141	151
Ala.	7.00	6.75	4.40	3.22	5.20	4.08	3.70	3.42	14	19	39.10	31.15	138	140
Miss.	6.50	6.30	4.60	3.82	5.90	4.45	4.60	3.80	16	19	40.90	31.20	119	124
La.	6.50	6.08	5.30	4.38	5.80	4.98	5.10	3.83	......	18	36.70	32.72	85	95
Tex.	7.20	6.65	5.60	4.58	6.60	5.32	5.00	4.35	15	16	53.60	43.35	95	95
Okla.	7.30	6.88	6.00	4.82	6.70	5.90	5.00	5.12	15	16	56.20	45.08	100	110
Ark.	6.50	6.00	4.80	3.78	6.00	5.18	3.90	3.88	15	18	44.30	31.38	103	111
Mont.	7.60	7.68	6.70	5.92	8.70	8.00	5.30	5.55	17	18	83.30	59.12	139	146
Wyo.	7.50	7.55	7.00	5.42	9.80	8.27	5.70	5.17	16	18	77.70	58.15	86	124
Colo.	7.70	7.30	6.90	5.90	9.00	7.63	6.00	5.20	16	16	68.60	53.90	102	118
N. Mex.	7.70	7.65	6.90	5.38	8.90	7.10	4.80	4.85	14	14	62.80	53.90	70	92
Ariz.	8.00	7.77	6.20	5.73	8.00	......	4.00	......	14	......	100.00	......	117	......
Utah.	7.00	7.25	6.00	5.55	8.10	8.22	5.50	5.62	15	14	70.40	52.25	126	116
Nev.	8.50	7.90	6.80	6.17	8.30	7.97	5.20	......	14	14	68.70	......	122	......
Idaho.	7.40	7.50	6.20	5.40	7.60	6.85	4.40	5.12	17	17	79.20	55.38	116	135
Wash.	7.80	8.02	7.00	5.68	7.70	8.55	5.10	5.48	16	16	77.70	61.40	127	153
Oreg.	7.50	8.18	6.60	6.05	8.30	7.65	4.50	5.35	17	16	69.10	51.52	101	125
Cal.	7.90	7.38	6.60	6.00	7.40	6.50	4.90	5.00	15	14	70.00	54.15	129	152
U. S.	7.60	7.14	6.33	5.30	7.59	6.34	4.87	4.99	17.2	17.9	59.85	46.84	139	140

[1] Hogs, cattle, calves, and sheep, dollars per 100 pounds; horses and cows, dollars per head; wool, cents per pound.

TABLE 12.—*Averages for the United States of prices paid to producers of farm products.*

Products.	May 15.					June 15.		April 15.		
	1914	1913	1912	1911	1910	1913	1912	1914	1913	1912
Hogs.........per 100 pounds..	$7.60	$7.45	$6.79	$5.72	$8.59	$7.61	$6.65	$7.80	$7.94	$6.78
Beef cattle..............do....	6.33	6.01	5.36	4.59	5.23	6.02	5.23	6.29	6.08	5.15
Veal calves.............do....	7.59	7.17	6.23	5.68	6.30	7.53	6.33	7.68	7.38	6.22
Sheep..................do....	4.87	4.91	4.74	4.51	5.79	4.84	4.52	4.96	5.16	4.67
Lambs..................do....	6.49	6.66	6.16	5.74	7.26	6.36	6.02	6.47	6.59	5.98
Milch cows.........per head..	59.85	54.80	45.63	44.54	42.38	55.20	45.84	59.60	55.34	45.14
Horses.................do....	139.00	145.00	144.00	146.00	148.00	146.00	145.00	138.00	148.00	142.00
Honey, comb.....per pound..	.137	.138	.137	.136	.132	.139	.140	.137	.141	.138
Apples...........per bushel..	1.46	.94	1.29	1.40	1.27	1.01	1.08	1.37	.85	1.15
Peanuts..........per pound..	.051	.047	.049	.048	.052	.050	.052	.049	.048	.049
Beans (dry)......per bushel..	2.31	2.18	2.52	2.17	2.17	2.23	2.62	2.11	2.11	2.37
Sweet potatoes..........do....	.93	.93	1.19	1.04	.82	.91	1.11	.92	.94	1.17
Cabbages.....per 100 pounds..	2.05	1.58	2.98	1.38	2.77	2.18	2.67	2.23	1.15	3.17
Onions...........per bushel..	1.53	.87	1.77	1.29	1.03	.96	1.55	1.60	.79	1.75
Wool, unwashed..per pound..	.172	.163	.178	.147	.228	.156	.187	.168	.177	.173
Clover seed.......per bushel..	7.87	10.74	12.53	8.74	7.47	9.77	11.69	8.06	11.00	12.91
Timothy seed...........do....	2.38	1.76	7.16	5.24	....	1.77	6.68	2.28	1.74	7.27
Alfalfa seed............do....	6.77	8.21	....	....	....	8.08	8.47	6.77	8.36	....
Broom corn..........per ton..	85.00	53.00	83.00	81.00	199.00	61.00	79.00	89.00	58.00	101.00
Cotton seed.............do....	23.56	21.88	19.21	25.46	....	21.54	19.24	24.17	21.89	18.62
Maple sugar......per pound..	.123	.123	.116	....	....	.121	.116	.125	.130	.125
Maple sirup.......per gallon..	1.10	1.08	1.09	....	....	1.09	1.05	1.10	1.10	1.08
Hops.............per pound..	.218	.134	.372	.209	.166	.141	....	.206	.150	....
Paid by farmers:										
Bran............per ton..	28.08	24.59	30.18	25.93	26.10	24.67	29.35	28.50	24.69	29.73
Cloverseed....per bushel..	9.77	12.90	....	....	....	12.47	13.49	9.84	12.90	....
Timothy seed.......do....	2.97	2.40	....	....	....	2.44	7.37	2.95	2.43	....
Alfalfa seed.........do....	8.38	9.75	....	....	....	9.73	10.25	8.17	9.90	....

TABLE 13.—*Range of prices of agricultural products at market centers.*

Products and markets.	June 1, 1914.	May, 1914.	April, 1914.	May, 1913.	May, 1912.
Wheat per bushel:					
No. 2 red winter, St. Louis..	$0.93½–$0.95½	$0.93 –$0.98½	$0.92 –$0.96	$0.95 –$1.12	$1.16 –$1.25½
No. 2 red winter, Chicago....	.95 – .96	.94 – 1.00¾	.92⅛– .95¾	.99½– 1.17⅜	1.10⅜– 1.20
No. 2 red winter, New York[1]	1.10½– 1.11	1.04 – 1.11½	1.03 – 1.05	1.12 – 1.15	1.18 – 1.27
Corn per bushel:					
No. 2 mixed, St. Louis.......	.70 – .70½	.69½– .73	.68½– .71½	.56 – .61	.79 – .85
No. 2, Chicago..............	.70 – .70¾	.67 – .72½	.64 – .69½	.55¼– .60	.76¼– .82½
No. 2 mixed, New York[1]....	....	....	.71 – .76½	.62¾– .66	.83 – .87½
Oats per bushel:					
No. 2, St. Louis..............	.39½– .40	.38½– .41	.38½– .41	.35 – .40½	.53 – .57¾
No. 2, Chicago...............	.39¼– .39½	.37 – .42½	.37 – .39⅝	.35⅛– .43	.50½– .58
Rye per bushel: No. 2, Chicago..	.65½– .65¾	.62 – .67	.60 – .63	.60 – .64	.90 – .95½
Baled hay per ton: No. 1 timothy, Chicago........	15.00 –16.00	15.00 –17.50	15.00 –17.00	14.00 –16.50	24.00 –28.00
Hops per pound: Choice, New York..............	.38 – .40	.38 – .41	.39 – .44	.20 – .23	.40 – .52
Wool per pound:					
Ohio fine unwashed, Boston.	.22 – .23	.22 – .23	.22 – .22	.20 – .21	.21 – .21
Best tub washed, St. Louis..	.31 – .31	.30 – .31	.29 – .30	.28 – .29	.31 – .35
Live hogs per 100 pounds: Bulk of sales, Chicago..............	7.95 – 8.00	7.80 – 8.67½	8.00 – 8.95	8.25 – 8.75	7.25 – 7.90
Butter per pound:					
Creamery, extra, New York..	.27 – .27½	.25½– .27	.24½– .26½	.27¼– .31	.26 – .35½
Creamery, extra, Elgin.......	.26¼– .26¼	.23½– .26	.23½– .25	.27 – .30	.25 – .31
Eggs per dozen:					
Average best fresh, New York	.22½– .24½	.22 – .24	.20 – .26	.21 – .25	.20½– .24
Average best fresh, St. Louis.	.17¼– .17¼	.17¼– .18¾	.17 – .18½	.17 – .17½	.16 – .17½
Cheese per pound: Colored,[2] New York..............	.13½– .13¾	.13 – .13¾	.13 – .16½	.12½– .14	.14 – .16

[1] F. o. b. afloat.
[2] September colored—September to April, inclusive; new colored—May to July, inclusive; colored—August.

TABLE 14.—*The equivalent in yield per acre of 100 per cent condition on July 1, in each State.*

States.	Corn.	Winter wheat.	Spring wheat.	Oats.	Barley.	Rye.	Potatoes.	Tobacco.	Flax.	Rice.	Hay.	Cotton.
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Lbs.*	*Bu.*	*Bu.*	*Tons.*	*Lbs.*
Maine	46.0		26.5	40.5	30.5		230				1.25	
New Hampshire	46.0			38.5	28.4		140	1,850			1.30	
Vermont	45.0		27.0	41.3	33.5	19.5	140	1,800			1.50	
Massachusetts	47.0			37.5		18.5	134	1,800			1.37	
Rhode Island	42.0			33.0			140				1.30	
Connecticut	51.0			36.0		20.0	120	1,720			1.35	
New York	43.0	22.5		36.0	29.5	19.1	110	1,300			1.50	
New Jersey	42.0	19.5		34.5		18.8	112				1.60	
Pennsylvania	46.0	19.2		35.5	28.5	18.0	96	1,540			1.60	
Delaware	36.0	18.2		35.5		16.0	107				1.65	
Maryland	39.0	18.0		33.0	32.3	16.7	100	800			1.65	
Virginia	28.0	14.0		24.5	30.0	14.0	100	870			1.50	265
West Virginia	33.5	14.6		27.5		14.0	101	860			1.55	
North Carolina	20.7	11.6		21.4		11.0	91	800		31.8	1.55	295
South Carolina	22.0	13.0		25.7		11.5	101	910		28.0	1.40	280
Georgia	17.0	13.0		23.4		10.6	91	900		31.0	1.60	240
Florida	16.0			20.0			104	920		30.0	1.50	145
Ohio	44.0	20.0		41.0	31.5	19.0	99	900			1.70	
Indiana	43.5	19.0		38.5	31.0	18.0	98	1,040			1.60	
Illinois	41.3	19.8		41.0	32.0	19.5	96	920			1.58	
Michigan	41.0	19.7		37.0	29.0	16.7	112				1.57	
Wisconsin	41.0	22.5	20.3	38.5	31.0	19.0	120	1,300	15.0		1.70	
Minnesota	40.0		17.5	40.0	29.5	22.0	124		11.0		1.85	
Iowa	39.5	25.0	18.2	38.0	30.0	20.5	100		11.8		1.65	
Missouri	35.0	18.0		34.0	27.5	17.0	92	1,100	8.2		1.50	345
North Dakota	32.0		14.0	34.0	25.0	19.4	115		9.8		1.50	
South Dakota	32.0		15.0	34.5	27.0	20.0	92		9.6		1.60	
Nebraska	30.0	23.0	17.0	32.5	27.0	19.0	90		9.8		1.60	
Kansas	24.5	19.0	16.0	35.5	26.0	18.5	85		8.5		1.60	
Kentucky	32.5	14.6		28.0	29.3	15.0	95	1,000			1.50	
Tennessee	29.0	12.8		25.7	28.5	13.3	88	900			1.65	242
Alabama	19.5	13.5		22.5		12.7	94	700		33.0	1.70	220
Mississippi	22.0	15.0		23.0			100			35.0	1.70	250
Louisiana	25.0			25.0			85	590		37.0	1.80	230
Texas	26.0	16.5		40.0	32.0	17.5	80	800		39.0	1.50	209
Oklahoma	23.0	17.5		36.0	31.0	15.5	80		11.0		1.35	225
Arkansas	24.5	13.2		28.5		12.7	90	770		43.0	1.55	238
Montana	30.0	30.0	26.5	49.0	36.5	23.5	160		10.9		1.95	
Wyoming	27.0	32.0	29.5	40.0	34.5	23.5	150				2.45	
Colorado	24.0	29.0	28.5	43.0	39.5	20.0	130		8.0		2.50	
New Mexico	29.0	24.3	25.0	38.0	35.0		95				2.60	
Arizona	35.0	32.0	27.5	45.0	41.0		105				3.60	
Utah	34.0	26.0	30.0	48.0	43.0	20.0	185				3.00	
Nevada	35.0	25.5	31.0	45.0	41.0		172				3.10	
Idaho	34.0	30.5	28.5	47.0	43.5	23.0	185				3.10	
Washington	30.0	28.6	22.0	52.0	42.3	22.0	165				2.40	
Oregon	31.0	25.5	21.0	39.0	37.0	18.0	140				2.30	
California	41.0	20.5		41.0	33.0	19.0	147			54.0	2.00	
United States	31.8	19.7	16.6	37.1	30.2	18.5	114.8	965.1	10.1	38.5	1.70	231.8

COTTON CONDITION MAY 25.

The Crop Reporting Board of the Bureau of Statistics (Crop Estimates), United States Department of Agriculture, estimates, from the reports of the correspondents and agents of the bureau, that the condition of the cotton crop on May 25 was 74.3 per cent of a normal, as compared with 79.1 on May 25, 1913, 78.9 on May 25, 1912, 87.8 on May 25, 1911, and 80.4, the average of the past 10 years on May 25. Comparisons of conditions, by States, are given in Table 15.

TABLE 15.—*Condition of cotton May 25, 1914, with comparisons by States.*

State.	May 25—				
	1914	1913	1912	1911	10-year average.
Virginia	83	83	89	93	86
North Carolina	76	76	87	83	85
South Carolina	72	68	83	80	79
Georgia	80	69	74	92	80
Florida	82	83	75	95	84
Alabama	85	75	74	91	80
Mississippi	87	81	72	86	79
Louisiana	82	81	69	91	78
Texas	65	84	86	88	81
Arkansas	79	85	73	87	80
Tennessee	80	87	74	83	82
Missouri	86	90	74	86	83
Oklahoma	68	87	78	87	84
California	100	96	96	95	....
United States	74.3	79.1	78.9	87.8	80.4

For purposes of comparison the condition of the cotton crop in the United States monthly and the estimated yield per acre for the past 10 years are given in Table 16.

TABLE 16.—*Condition of cotton in the United States monthly and yield per acre, 1904–1913, inclusive.*

Year.	May 25.	June 25.	July 25.	Aug. 25.	Sept. 25.	Yield per acre.
						Pounds lint.
1913	79.1	81.8	79.6	68.2	64.1	182.0
1912	78.9	80.4	76.5	74.8	69.6	190.9
1911	87.8	88.2	89.1	73.2	71.1	207.7
1910	82.0	80.7	75.5	72.1	65.9	170.7
1909	81.1	74.6	71.9	63.7	58.5	154.3
1908	79.7	81.2	83.0	76.1	69.7	194.9
1907	70.5	72.0	75.0	72.7	67.7	178.3
1906	84.6	83.3	82.9	77.3	71.6	202.5
1905	77.2	77.0	74.9	72.1	71.2	186.1
1904	83.0	88.0	91.6	84.1	75.8	204.9
10-year average	80.4	80.7	80.0	73.4	68.5	187.2

APPLE MOVEMENT, 1913.

The commercial apple crop of 1913 was considerably less than in the preceding year, as indicated by the quantities of apples shipped by rail and water, which amounted to 64 per cent of the shipments for the preceding season. The greatest falling off was in the North Central States west of the Mississippi River, where the movement in 1913 was scarcely one-third of that of the preceding season. This low average is borne out consistently by a number of individual reports from apple-carrying railroads, all of which show very small shipments compared with the season before.

It is to be noted that the commercial crop constitutes a relatively small part of the total apple crop of the United States, possibly as low as one-fourth or even one-fifth of the total crop. Hence, it is not to be expected in all cases that the commercial crop will increase or decrease from year to year at exactly the same rate as the total crop. An estimate based upon the percentages of a full crop, as published in the Agricultural Outlook for November, 1913, indicates that for the United States the entire apple crop of 1913 was 65 per cent of that of 1912. This happens to be practically the same as the relation of the commercial crop of 1913 to the preceding year. In the New England States, the South Central east of the Mississippi River, the Mountain, and the Pacific States, whose full crop of apples in 1913 was represented, respectively, as 67, 65, 91, and 68 per cent of the 1912 crop; while their shipments in 1913, as compared with 1912, were represented, respectively, by 65, 66, 95, and 72 per cent of the preceding year. With the other geographic divisions the agreement was not so close. The full crop for the Middle Atlantic, South Atlantic, North Central east, North Central west, of the Mississippi River, and the South Central west of the Mississippi River, in 1913, was represented, respectively, by 55, 32, 83, 74, and 72 per cent of the 1912 crops; while the shipments in 1913 equaled 69, 50, 67, 31, and 93 per cent, respectively, of the preceding season. Such disagreement between the full crop and the commerical crop, as stated above, is to be expected, especially in regions where the noncommercial apples constitute a large part of the total crop.

The figures shown in Table 17 are based upon reports from a large number of individual transportation companies, including by far the greater number of the boat lines in apple-producing regions and railroads operating at least four-fifths of the total mileage of the United States.

TABLE 17.—*Apples carried on railroads and boat lines in the United States, June 1 to Nov. 30, 1913.*

[Representing practically shipments out of producing regions for the crop of 1913. As reported for about four-fifths of the total railroad mileage of the United States; also for all but a few boat lines in apple-producing regions. Some reports refer to periods different from the one mentioned in the table, but nevertheless represent practically the shipments out of producing regions for the crop year.]

Geographic division.[1]	Shipments reported June 1 to Nov. 30, 1913. Quantity.	Percentage of corresponding 6 months, 1912.
	Bushels.	*Per cent.*
New England	1,114,000	65
Middle Atlantic	12,023,000	69
South Atlantic	2,234,000	50
North Central:		
East of Mississippi River	3,893,000	67
West of Mississippi River	1,837,000	31
South Central:		
East of Mississippi River	80,000	66
West of Mississippi River	791,000	93
Mountain	2,537,000	95
Pacific	4,144,000	72
United States	28,653,000	64

[1] Geographic divisions are constituted as follows: *New England:* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut; *Middle Atlantic:* New York, New Jersey, Pennsylvania; *South Atlantic:* Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida; *North Central, east of Mississippi River:* Ohio, Indiana, Illinois, Michigan, Wisconsin; *west of Mississippi River:* Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas; *South Central, east of Mississippi River:* Kentucky, Tennessee, Alabama, Mississippi; *west of Mississippi River:* Arkansas, Louisiana, Oklahoma, Texas; *Mountain:* Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada; *Pacific:* Washington, Oregon, California.

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SUDAN GRASS AS A FORAGE CROP.

By H. N. Vinall, *Agronomist, Office of Forage-Crop Investigations.*

INTRODUCTION.

The discovery of this new hay grass (Sudan grass) came about as the result of a search for forms of wild andropogons which do not have rootstocks. It is acknowledged by agriculturists that Johnson grass, which belongs to this group, would be a valuable hay plant for the Southern States if it were not supplied with aggressive underground stems. Recognizing this fact, an organized search for forms lacking these rootstocks was begun under the direction of Prof. C. V. Piper, in charge of the Office of Forage-Crop Investigations, with the assistance of the Office of Foreign Seed and Plant Introduction. As a result of this effort [1] a grass was obtained under the name garawi on March 16, 1909, from Mr. R. Hewison, Director of Agriculture and Lands of the Sudan Government at Khartum. One-half pound of seed was received, and a portion of this small quantity was planted at the Forage-Crop Field Station, Chillicothe, Tex., that spring. The grass looked very promising there and plans were immediately laid for extending the plantings to other points. In order to give it distinctiveness and assist in its distribution, the name Sudan grass was applied to it.

DESCRIPTION OF SUDAN GRASS.

Under cultivation in the United States, Sudan grass has shown itself to be distinctly an annual. In only two instances under our observation have plants lived over winter—at Gainesville, Fla., and

[1] Piper, C. V. Sudan grass, a new drought-resistant hay plant. U. S. Department of Agriculture, Bureau of Plant Industry Circular 125, 1913.

Oakley, R. A. Some new grasses for the South. *In* Yearbook, Department of Agriculture, for 1912, pp. 499–504.

Note.—Demands for information regarding this new hay plant have come from nearly every section of the United States, but more especially from the Southern States, where the need of a desirable hay grass has been acute since the advent of the boll weevil forced diversification of crops. This bulletin is designed to meet this demand by making available the information at hand.

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Bard, Cal., both places being practically frost free. This grass is very closely related to the cultivated sorghums and hybridizes with them readily. The fact that it has no rootstocks places it nearer the cultivated sorghums than is Johnson grass, which for many years has been credited by some botanists with being the wild prototype of the sorghums.

FIG. 1.—A typical plant of Sudan grass, showing erect growth, leafiness, and stooling habit. Grown in cultivated rows at Arlington farm, Virginia, 1913.

Sudan grass when seeded broadcast or in drills averages about 3 to 5 feet in height and has stems a little smaller than a lead pencil, being about three-sixteenths of an inch in diameter. If grown in rows and cultivated it reaches a height of 6 to 9 feet, and the stems are larger than usual, being about one-fourth of an inch in diameter. (See fig. 1.) The panicle is loose and open, very much like that of Johnson grass, but a little larger and a trifle more compact. The hulls, or glumes, are awned and when in flower often purplish in color. This color usually fades to a light yellow when ripe. The awns are broken off in thrashing, so that the commercial seed rarely has awns. The leaves are broader and more numerous than those of Johnson grass, giving the grass a much more favorable appearance as a hay plant. The most important difference, however, is that the aggressive underground stems, or rootstocks, with which Johnson grass is equipped, are entirely absent in Sudan grass. This striking difference is shown clearly in the accompanying figure illustrating

FIG. 2.—Young plants of Sudan grass (left) and Johnson grass (right), showing the vigorous rootstocks of Johnson grass and their entire absence on Sudan grass.

young seedling plants of the two grasses (fig. 2). Sudan grass, like the cultivated sorghums, never develops anything but fibrous roots, therefore it can not become an obnoxious weed comparable to the perennial Johnson grass. Furthermore, it has shown no tendency to persist in fields as an annual weed through volunteer seedings. When given plenty of room, the grass stools very freely. It is not uncommon to find over 100 stems arising from one crown. This decided tendency to stool is most apparent after the first cutting, and this characteristic makes the hay from the second cutting usually of finer texture than that from the first.

TUNIS GRASS.

Another form of *Andropogon sorghum* closely related to Sudan grass was secured from Dr. L. Trabut, Algiers, Algeria. This has

FIG. 3.—Tunis grass grown in cultivated rows, Arlington farm, Virginia, 1912. Note the difference in leafiness and general vigor as compared with the Sudan grass shown in figure 1.

been given the name Tunis grass, but it seems that the seed originally came from Egypt. It also is devoid of rootstocks, but is less leafy and not quite so vigorous as Sudan grass (fig. 3) and has the characteristic of shattering its seed readily, owing to the formation of a layer of scar tissue where the seed breaks from the rachis branches. The formation of this tissue at the base of the seed causes the seed to fall, in the same way that the production of the leaf scar on trees in the autumn starts the shedding of leaves. In most cases Tunis grass will lose practically all its seed while the leaves are yet green. So far there seems to be no place in the United States where it is superior or even equal to Sudan grass.

CLIMATIC REQUIREMENTS OF SUDAN GRASS.

Sudan grass, like other sorghums, does best in a warm climate. In favorable seasons, where the growing period is long, as many as four cuttings can be obtained in one year. As is the case with all other crops, in determining the regions of greatest importance climatic and soil conditions are linked with the acuteness of the need for such a crop. For example, in the present instance Sudan grass promises to become of most importance throughout Texas, in western Oklahoma, western Kansas, western Nebraska, and central South Dakota, as illustrated by region 1 of the map shown as figure 4. This is not because it makes better yields here than in region 4, but because there

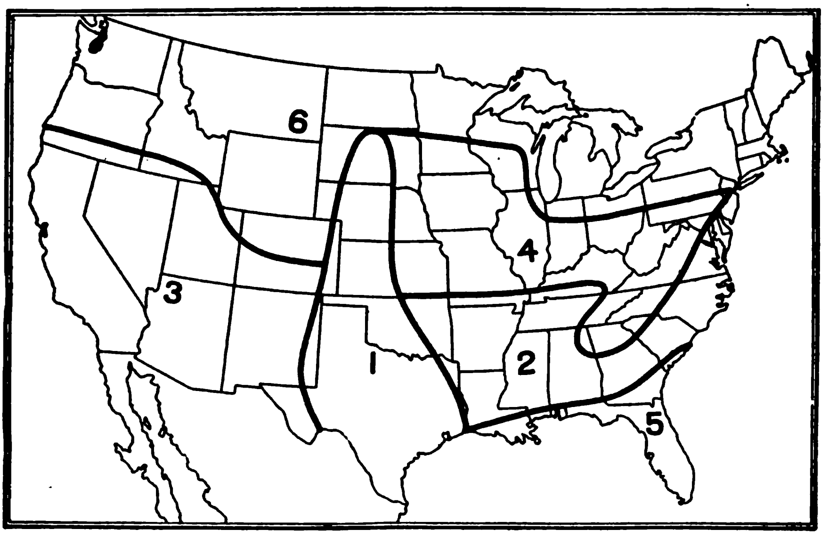

FIG. 4.—Map of the United States, showing the regions to which Sudan grass is more or less well adapted and also those where its production is regarded as impracticable. 1, The region in which Sudan grass promises to be of most value and in which it is expected to become the most important hay grass; 2, apparently almost as valuable here as in region 1, though the data are as yet inconclusive; 3, produces abundantly under irrigation, and the grass seems destined to become second only to alfalfa as a hay crop; 4, recommended only as a substitute for millet in its use as a catch crop or for growing in situations where neither timothy nor alfalfa succeed well; 5, results in this region are unfavorable; 6, not of any considerable value, the region being too cool for the proper development of the grass.

has been found no other satisfactory hay plant, generally speaking, for region 1, while in region 4 timothy, clover, and alfalfa all do well and there is no strong demand for another hay plant. Region 1 extends north to the south line of North Dakota, because in the central Great Plains the summers are sufficiently warm and long enough to mature one cutting, and in some cases two cuttings of Sudan grass, thus giving this region a hay of good quality to replace the millets. At Brookings, S. Dak., it has done well for two years, making hay yields much in excess of those produced by millet and maturing abundant crops of seed. In the southern part of the United States, designated on the map as region 2, the climatic conditions are also favorable to the production of this grass, but there are found there several other grasses and legumes which partially fill the need for a hay crop. The results of tests in this region have been quite favorable, but sufficient data have not been obtained to warrant recommending the use of Sudan grass as the principal hay crop. In the southwestern part of the United States, included in region 3 on the map, Sudan grass will no doubt be extensively grown under irrigation, since the yields of both hay and seed have been highly satisfactory. Its value in alfalfa-growing communities will no doubt depend very largely on its ability to furnish a change of feed without loss of tonnage.

It is likely that Sudan grass will supersede the millets as catch crops in most of the region east of the Rocky Mountains, south of the southern boundary of New York, and north of Tennessee. (See region 4, fig. 4.) The yield from one cutting in this region is not apt to exceed that of German millet, but if handled properly two cuttings can be obtained in many cases, and the quality of the hay is much superior to that of millet hay. Near the Gulf coast the humid atmosphere and continuous heat favor the development of the red-spot disease (sorghum blight) and thus reduce the yield. (See region 5, fig. 4.) This is true to some extent also on the Atlantic coast of the Southeastern States.

Continued cool weather, such as one encounters in high altitudes, is detrimental to the growth of Sudan grass. This fact precludes its successful production in the intermountain section, including most of Wyoming and Montana and considerable of Utah, Colorado, Idaho, Oregon, and Washington. (See region 6, fig. 4.) Results in these States have for the most part been unfavorable. At Burns, Oreg., the yields of Sudan grass varied from 350 to 500 pounds per acre. At the State experiment station, Corvallis, Oreg., it was reported as of much less value for hay than vetch and oats. At Moro, Oreg., the yield was 1,780 pounds per acre, but even there it was doubtful whether it would supersede grain hay. At Adams, in Umatilla County, Oreg., it did poorly also. At Walla Walla, Wash., when seeded at the same time and under the same conditions as alfalfa, it made less growth, although alfalfa is usually slow in starting. At Laramie, Wyo., with an altitude of 7,188 feet, it made only 6 inches of growth.

SOIL REQUIREMENTS.

Sudan grass is not at all exacting in its soil requirements. It does best on a rich loam, but it has been grown successfully on almost every class of soil from a heavy clay to a light sand. Where the soil is quite sandy, however, the yield may be expected to be light. To do well, the ground must be fairly well drained.

DROUGHT ENDURANCE.

The value of Sudan grass under conditions of extreme drought has not been definitely established. Reports from those testing it do not agree on this point. Reports from the South, where lack of moisture has been combined with extreme heat, have in general been favorable to this grass in comparison with millets and sorghums. Farther north most of the reports indicate that, grown under extreme drought conditions, it produces less than millet. It may be that high temperature, which is known to be necessary to the best development of the grass, is the deciding factor. During 1913, when the drought was especially severe in the central Great Plains region, direct comparisons of Sudan grass and millet indicated that the latter is capable of making better yields under such conditions.

The following extract from a letter of Joseph E. Maxwell, superintendent of the Kaibab Indian School, Moccasin, Ariz., is interesting, as showing the evident difference in the relative behavior of Sudan grass farther south:

> All the sorghum planted this year was a failure on account of the extreme drought early in the season. No moisture fell to wet the ground from early in March until July 18, and then the ground was wet to the depth of only about 3 inches. * * * The Sudan grass was planted on May 15, while the ground was quite dry. * * * The Kafir corn and other sorghum planted in the same field died out, but the Sudan grass kept growing through the dry weather.

A photograph accompanying Mr. Maxwell's letter shows the grass to have reached a height of over 5 feet. Confirming this report are the experiences of F. J. McCarthy, Boerne, Tex., J. R. Stegall, Detroit, Tex., and others, recorded on pages 17 to 20 of Circular 125 of the Bureau of Plant Industry.

It is possible that Sudan grass may not produce as much hay per acre as the millets under exceptionally unfavorable conditions, but in ordinary years it will yield two cuttings and will, like other sorghums, stand semidormant through a period of drought, and if rain comes before the end of the growing season it will immediately renew its growth. In very few instances have millets been known to do this. It is believed, therefore, that during a term of 12 or 15 years, even considering the whole Great Plains region, Sudan grass will outyield millet.

CULTURE.

PREPARATION OF THE SEED BED.

In seeding Sudan grass a rather firm seed bed is best. Usually, when it is desired to drill the seed, the ground is plowed in the spring and harrowed down well, as for corn. A cool soil delays the germination of the seed; hence, spring plowing is preferable for the seed bed, because it assists in warming the soil. No fertilizers are necessary in the West, where the soil is reasonably good, but in the East it is probably advisable to use some complete fertilizer, such as is applied for corn. No experiments, however, have been carried out to determine the best practice to follow.

FIG. 5.—Sudan-grass seedlings, showing the effect of planting at different depths. From left to right the plants are from seeds sown, respectively, ½ inch, ¾ inch, 1½ inches, 2 inches, and 3 inches deep.

DATE OF SEEDING.

It has been found best to seed Sudan grass after the soil has become warm, about corn-planting time or a little earlier. When sown in cold soil the result is usually a poor stand or slow growth for several months, so that in the end no advantage has accrued from the early seeding.

Widely scattered experiments have shown that in very few cases are the earliest seedings highest in yield. The experience so far gained by the Department of Agriculture in its tests indicates that for the extreme South the best time for seeding lies between April

1 and 15; farther north, in the latitude of Oklahoma and Kansas, April 15 to May 15 is most profitable; and north of that, in the latitude of Nebraska and South Dakota, May 1 to June 1 has given the best results.

METHOD OF SEEDING.

In regions of abundant rainfall, for hay production the best machine for seeding is no doubt the common grain drill. Well-cleaned seed feeds freely from this drill, and it can be distributed evenly and a good stand thus secured. If a press drill is used, the ground is left level and in good condition for the mower. The depth of seeding has but little effect on the root system of Sudan grass. It seems to be a characteristic of the grass that the root

FIG. 6.—Sudan grass grown in 42-inch rows for seed production, on the farm of R. E. Thompson, Stillwater, Okla.

system begins near the surface of the soil, regardless of the depth at which the seed is placed. (See fig. 5.) The best depth, everything considered, is from one-half to 1 inch, but where the soil does not become packed the plant will force itself to the surface even from a depth of 3½ to 4 inches.

In the semiarid regions for hay, and in any locality for seed production, better results are obtained by seeding it in rows far enough apart to allow cultivation. This can be accomplished with the grain drill by stopping up a sufficient number of the holes so that the rows seeded will be the desired distance apart. Where only the ordinary corn cultivators are available for the work it is best to place the rows 36 to 42 inches apart. (See fig. 6.) If a beet cultivator or some similar tool is available, larger yields can be obtained from rows 18 to 24 inches apart. The latter distance (24 inches) is perhaps as close as practicable, unless horses especially trained to walk between the rows are to be had. If such is not the case, much of the stand will be destroyed by trampling. It has been found in carefully planned experiments that the cultivated-row plantings are apt to give the larger yields under irrigation. Against this difference in favor of the cultivated-row planting over the broadcasted field will have to be charged the cost of cultivation. There is also in many cases a better quality of hay produced from the broadcast stand, owing to the finer stems. The grass grown in cultivated rows is apt to be coarse and therefore not so desirable for market hay. For home feeding the coarseness will be of little disadvantage, as the stems do not become so woody that they are refused by stock.

RATE OF SEEDING.

When sown broadcast, 16 to 24 pounds of good clean seed per acre are necessary. In the arid districts a light seeding is most profitable, while in the humid sections or under irrigation 24 pounds per acre is none too heavy. If the ground is weedy or the seed bed poorly prepared, 30 pounds is better. For seeding in cultivated rows 36 to 44 inches apart, 2 to 4 pounds of seed per acre will be found sufficient, while in rows 18 to 24 inches apart, 4 to 6 pounds per acre will be required, the less quantity being used, as in the broadcast seedings, for regions of light rainfall. When a seed crop is desired, the rate of seeding should ordinarily be somewhat less than for a hay crop.

SUDAN-GRASS AND LEGUME MIXTURES.

The suitability of Sudan grass for growing in mixtures with cowpeas, soy beans, and other legumes is at once apparent, for several reasons. Sudan grass grows strictly erect, with a stem stiff enough to support the vines characteristic of most legumes, and it thus makes the harvesting easier by keeping the legumes off the ground. It also allows them to cure more quickly by preventing the leaves from matting. It is low in protein, which is prominent in legumes, and thus a well-balanced mixture is produced. The yields, although they are not often as great as that of Sudan grass alone, are so large that little forage weight is lost by the intermixture of legumes, and the feeding value of the hay is considerably enhanced.

The yields obtained from such a mixture in 1913 varied from 1 to 3½ tons per acre. The best showing was made at the Maryland experiment station, where the yields averaged about 3¼ tons of cured hay per acre. In 1912, at Arlington farm, Virginia, the mixture of Sudan grass and cowpeas gave a yield of 4.6 tons of cured hay per acre, while Johnson grass in mixture with the same variety of cowpeas made a yield of only 2.8 tons per acre. (See fig. 7.) Sudan grass in mixture with soy beans the same year made a yield of 4.4 tons per acre.

HARVESTING.

The most common way of harvesting the grass for hay is with a mower. It cures readily and can be cut in the morning and raked up that afternoon or the next day if the sun is bright. After bunching, it is placed in cocks, similar to millet, and removed from these cocks to the barn or stacks after it has thoroughly cured. The leaves are retained well, and if it has been cut at the right stage of maturity and handled properly it will make a bright, leafy, sweet hay of the

FIG. 7.—Plats at Arlington farm, Virginia, in 1912, showing mixtures of Sudan grass and cowpeas (right) and Johnson grass and cowpeas (left).

very best quality. Where the crop is desired for seed, it is harvested like the small grains with an ordinary grain binder and allowed to cure in shocks. This method can also be used in making hay in the semiarid regions where good drying weather prevails, so that the grass will cure in the shock.

Where the planting is made in cultivated rows, a corn or row binder can be used, but in a majority of cases a grain binder is preferable. In some cases, where the growth is rank, trouble is experienced in getting the reel over the tops of the plants and at the same time cutting a short stubble. The time for cutting is governed to some extent by the fact that several cuttings are expected in most cases, and this makes it most profitable to cut the first time as early as possible, so that the grass will have more time for growth. Sudan grass makes the best quality of hay if cut after full bloom, and when there remains no chance for an additional cutting the hay will be improved by waiting until this stage of maturity is reached. When cut for seed, the first heads should be fully ripe, as the stools will ripen somewhat later than the main stem and there is little loss from shattering.

There are very few hay grasses which are injured so little by standing beyond the proper stage of maturity as Sudan grass. This is due largely to the numerous stools, which, arising from the base, mature successively later than the main stem and always furnish immature stalks, even when the main stem has ripened. There is, in addition, the fact that most of the sorghums hold their leaves well and make the best quality of fodder when the seed has reached the dough stage. This characteristic makes it possible, where necessary, to extend the haying process over a long period without any material loss either in the quantity or quality of the hay. Such a feature is of great importance to the farmer, since the cutting time for his hay often comes when he is rushed with other work, or his haying may be interfered with by rains and thus prevent him from cutting at the most favorable time.

ROTATIONS.

Sudan grass, being an annual, can be fitted into any rotation without much trouble. Very little benefit to the soil will result from growing it, however, as it is a rank feeder and leaves nothing in the soil for improvement except the decaying roots. It can perform no such office as the legumes, which are known to benefit the soil by the addition of nitrogen through nodules on the roots. It will, however, furnish hay and afford a change in crop, which usually benefits the soil.

UTILIZATION.

HAY.

As stated previously, the hay from Sudan grass is of first-class quality and the yields are quite satisfactory, so that the grass will no doubt be most largely utilized as a hay crop. From the central United States southward it will be possible to get two cuttings, and in favorable instances as many as four cuttings have been secured. From seeding to the first cutting 75 to 80 days are necessary. The second cutting comes on about 45 days after the first one, and the third one is likely to take a little longer—50 to 55 days. This means that the growing season must extend over a period of six months to get three cuttings. By cutting the grass a little earlier each time four cuttings can be obtained in the same period. This was done at Chillicothe, Tex., in 1912. A plat was seeded April 26 and the following cuttings obtained:

Date.	Yield per acre.	Growing period.
	Pounds.	*Days.*
June 22	2,140	57
July 17	1,810	25
August 20	3,050	34
October 14	1,800	55
Total	8,800	171

It is quite probable that an equally large yield of hay of better quality would have been obtained from three cuttings, as this would have given time for each cutting to reach the proper stage of maturity. In 1913, when conditions were unusually severe in the Great Plains region, the following hay yields in tons per acre were recorded for Sudan grass when it was sown at the most favorable time: In western and central South Dakota, 1¼ to 2 tons; eastern South Dakota and southern Minnesota, 4¾ to 5 tons; eastern Colorado and northern Texas, 1½ to 2¼ tons; in the eastern United States (Maryland and Virginia), 2¼ to 3¾ tons; and farther south (Tennessee, Mississippi, Louisiana, and Florida), 2 to 5½ tons.

These yields were all made without irrigation. When irrigated, the yields compared favorably with those of alfalfa, as shown in the following pages. In a few localities millet has given a slightly larger crop than Sudan grass, but comparisons between these two crops have been based on one cutting only. When the very much better quality of the Sudan-grass hay and the probability of two or more cuttings are taken into account there is little doubt that Sudan grass will eventually replace the millets as the most widely used catch crop.

FEEDING VALUE.

That Sudan grass is palatable has been demonstrated on numerous occasions, but so far no feeding experiments have been carried out to determine its digestibility. It has been reported by farmers, however, that cattle have done well when fed on the hay. Numerous analyses of the grass have shown it to be about the same in chemical composition as Johnson grass and timothy hay. The percentage of protein decreases from the heading period until the seed is ripe, but the value of the grass for hay is no doubt as great about blossoming time as at any previous stage. This comes from the increase in yield as well as the improvement in digestibility. Nearly all immature forage is inclined to be laxative and probably does not remain in the digestive tract sufficiently long to permit the complete assimilation of the food elements.

VALUE IN IRRIGATED SECTIONS.

In many of the irrigated sections of the West, where alfalfa is the principal crop and dairying the chief industry of the people, alfalfa has been made the constant and the almost complete diet of the cows. The continuous use of this high-protein hay has caused digestive troubles, and this derangement of the digestive functions seems to disappear promptly when the feed is changed. In such sections south of Oregon and Wyoming, Sudan grass would make an excellent crop to grow for mixing with the alfalfa. Yields of cured hay obtained under irrigation the past year in California and Arizona have been equal and in some cases superior to those from alfalfa. At Chico, Cal., Sudan grass when irrigated gave a yield of 9.8 tons of cured hay per acre against a yield of 8.3 tons of alfalfa hay; at Bard, Cal., in the extreme southern end of the State, Sudan grass on favorable soil gave a yield of 8 tons of hay per acre against a yield of 7.9 tons of alfalfa. The yield of 8 tons at this place was made notwithstanding the fact that the grass was planted almost a month later than it should have been. At Phoenix, Ariz., the yield of Sudan grass was 7.8 tons per acre, as compared with a yield of 9.8 tons of alfalfa, and at Owens, Ariz., it made a yield of 4.5 tons per acre with only one irrigation during the season.

These unusual yields of hay from an annual crop which by its nature can be made to fit into any rotation will no doubt mean much to the dairying industry of the Southwest.

The percentage of moisture is apt to be somewhat greater in Sudan grass than in the alfalfa when the weights are taken directly from the field, but there is less labor necessary to handle the Sudan grass because the maximum yield from it will be secured in three cuttings, while with the alfalfa five or more cuttings will be required to produce the yields mentioned.

This is the first grass yet found which will yield under irrigation in the Southwest even approximately as much as alfalfa. It can be used, therefore, in providing a change of feed without any loss in the tonnage obtained from the land. It has appeared just in time to solve this problem which only in the last two or three years has become acute and for which dairymen have just begun to clamor for a solution. Sudan grass is not as rich in protein as alfalfa, but when mixed with alfalfa or fed with some concentrate rich in protein the limited experience indicates that the flow of milk will be nearly or quite normal.

SOILING AND SILAGE.

Sudan grass is suited admirably for use as a soiling crop, since it makes a large yield and is very palatable in the green state as well as when cured for hay. Enormous yields are secured under irrigation, because the growth is so rapid and the recovery from cutting so prompt. A small area in the South, where the rainfall is adequate or where irrigation is possible, can be made to support a goodly number of animals by this method.

No trial of Sudan grass as silage has as yet been carried out, but judging from its palatability and its succulence it would be excellent for this purpose, especially in mixtures with legumes. A mixture of Sudan grass and cowpeas or soy beans could be grown for silage as well as for hay. Its use for silage will no doubt be very limited, owing to the ease of making it into hay and the fact that there is little waste in feeding it.

PASTURE.

No pasture tests have yet been completed, but Sudan grass seems to lack several of the essentials of a good pasture: First, it is an annual and the ground would necessarily be soft and considerable injury from trampling would result, since it does not form a turf; second, live stock pasturing on it would, no doubt, pull out quite a number of plants; and finally, being a sorghum, it may, in some cases, be a carrier of prussic acid, which is quickly fatal to cattle when occurring in considerable quantity.

SEED PRODUCTION.

Probably in no other feature is Sudan grass any nearer perfect than in its seed habits. It produces seed freely in a loose, open panicle, which is carried well up by the stem, so that it can be harvested easily. The seed is retained well, and thus the loss from shattering is much less than in other wild forms of sorghums. The seed does not break from the rachis with a scar, but carries a portion of the rachis branch with it. Fields have been left standing long after the seed was ripe, and except for that eaten by birds little was lost.

Harvesting is accomplished most economically with an ordinary grain binder. When the seed is practically mature, Sudan grass can be cut and bound like grain and left to cure in shocks. It may then be hauled directly to the thrashing machine or stacked in the same manner as grain. The thrashing machine used for wheat and other small grain will thrash and clean the seed perfectly if it is well matured when harvested. If cut too early the seed will be chaffy, and there is likely to be some loss from being blown over in the straw when it is thrashed.

A clover huller has also been used in some cases with success. Seed thrashed in a clover huller is apt to be more thoroughly freed from the glumes than when thrashed in a grain thrasher. The weight of the seed varies from 30 to 40 pounds per bushel, but good seed will weigh about 40 pounds to the bushel and can be seeded without trouble through the ordinary type of grain drill. The yields are such that seed growing at present prices is extremely profitable. The following yields per acre of cleaned seed were obtained mostly from small plats, but they are indicative of what may be expected under favorable conditions: In Virginia, 450 to 500 pounds; Ohio, 800 pounds; Minnesota and eastern South Dakota, 800 to 1,400 pounds; eastern Colorado and northern Oklahoma, 400 pounds; northwestern Texas, 550 to 650 pounds; southern Texas,

FIG. 8.—A field of Sudan grass on the farm of J. C. Burns, Lubbock, Tex., in 1913. This field yielded over 500 pounds of clean seed per acre without irrigation.

900 pounds. Under irrigation the yield per acre at Rocky Ford, Colo., was 1,600 pounds; at Davis, Cal., 1,150 pounds; at Chico, Cal., 1,200 pounds; and at Phoenix, Ariz., 2,250 pounds.

The best seed yields of Sudan grass may be expected in the West, where warm, dry weather prevails. (See fig. 8.) Owing to the unusual success of this grass in 1912 and 1913, the price of seed has become excessively high. During the winter of 1913–14 seedsmen asked $1.50 to $2.25 per pound for the seed, and farmers sold it in quantity for 50 cents to $1.50 a pound. These prices can not long continue, as the grass seeds so abundantly.

The seed of Sudan grass resembles Johnson grass very closely, except that it is larger and more plump. It is only through a critical examination that they can be distinguished (fig. 9), and this fact emphasizes the importance of growing the two grasses separately. The adulteration of Sudan-grass seed would be an easy matter, but the chief danger doubtless lies in accidental admixture through the production of seed on fields infested with Johnson grass. To avoid this it would be advisable when the seed becomes abundant to use only

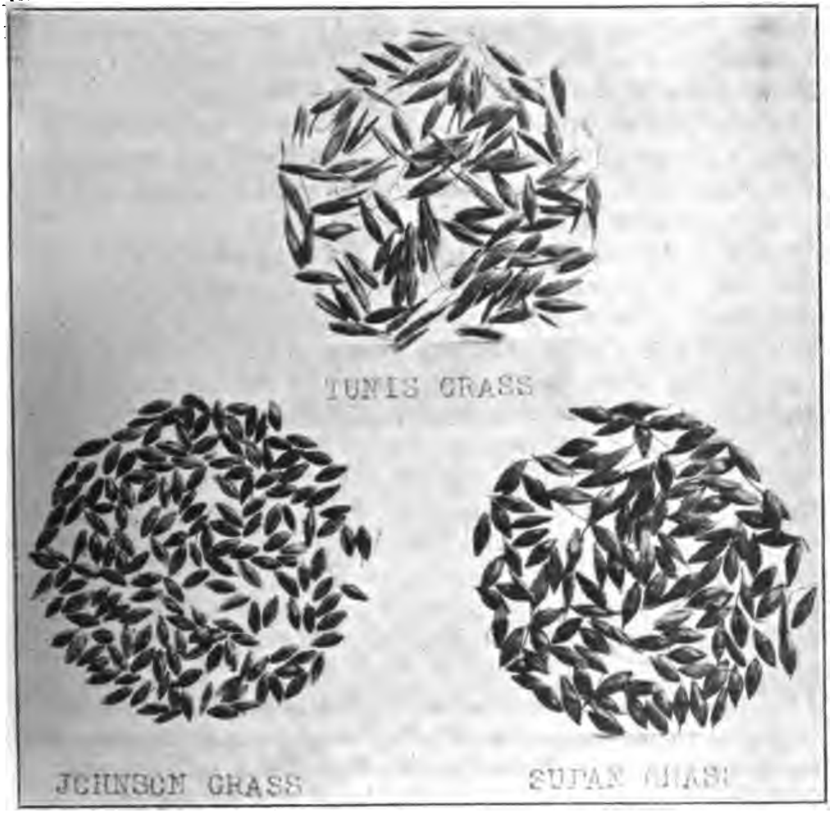

FIG. 9.—Seeds of Tunis grass, Johnson grass, and Sudan grass. (Natural size.) Note the difference in size between the seed of Johnson grass and of Sudan grass.

that produced in the North beyond the Johnson-grass area. It is likely that in time, as the demand becomes more permanent and the farmers are educated to ask for seed from a section of the country known to be free from Johnson grass, there will be definite areas devoted to Sudan-grass seed production, just as there are regions devoted to the production of German millet and Kentucky bluegrass seed. Within a few years the price of seed will no doubt be reduced to 4 or 5 cents a pound.

ENEMIES.

Diseases.—The worst disease that so far has developed is the so-called sorghum blight,[1] more appropriately designated as red-spot. This disease is characterized by the appearance of distinct reddish spots or blotches on the leaves, these spots gradually spreading until the leaves turn brown and die. Its effect on the plant is much the same as rust and, like the rust, it is most destructive in warm, humid regions. Sorghum blight is one of the chief drawbacks to the culture of Sudan grass on the Gulf coast, but it seems possible to overcome this weakness by the production of disease-resistant strains.

Another disease which is apt to be slightly troublesome in the South is the grain smut of sorghum. This will not become of any great importance, however, since Sudan grass is certain to be used almost exclusively as a hay crop.

Insects.—Among the insects which are to be considered in connection with the growing of Sudan grass the chinch bug and grasshoppers are so far of most importance. Grasshoppers are very fond of this grass, and when abundant will do immense damage. Chinch bugs also like it, and little can be done to prevent the attacks of these pests by any treatment of the crop. The grasshoppers can best be controlled by the distribution of poisoned bran baits around the edges of the field, while the chinch bugs may be destroyed in their winter quarters through the burning of the bunch-grass and trash in which they usually are found hiding, or their access to the Sudan-grass field is prevented by means of dust furrows, ditches, or oil barriers. The sorghum midge also is destructive in the South, where it prevents the formation of seed in Sudan grass, as it does in other sorghums.

Animals.—Moles, squirrels, and other rodents which injure the stand of perennial crops, like alfalfa, do not harm Sudan grass much, because it is resown annually, and this places such animals at a disadvantage.

Weeds.—No serious weed pests interfere with the production of Sudan grass, for the same reason that animals are of minor importance, as the annual cultivation of the soil destroys all but annual weeds and the grass grows so rapidly that such weeds are not likely to crowd it out.

BREEDING.

The Sudan grass imported from Africa seemed quite free from impurities and very uniform in growth, so that in the original crop

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[1] Kellerman, W. A., and Swingle, W. T. Sorghum blight. *In* First Annual Report, Kansas Agricultural Experiment Station (1888), pp. 281–302.

Burrill, Thomas J. A disease of broom-corn and sorghum. *In* Proceedings, Society for the Promotion of Agricultural Science (1887), Eighth Annual Meeting, pp. 30–36.

Radais, Maxime. On the blight of sorghum. *In* Botanical Gazette, vol. 28, no. 1 (1899), pp. 65–68.

there was but little room for selection. The second and third year, however, it began to show signs of having crossed quite freely with the sorghums, and in these hybrid plants and their progeny there is sufficient variation to satisfy any breeder. (See fig. 10.) Some decidedly promising silage and soiling types have appeared in the progeny, and these are being watched and propagated with the idea of developing strains adapted to special conditions and uses. It is doubtful whether any improvement will be made in the original grass as a hay type; therefore it is important that this original type should be maintained in a pure state. Its fine stems and splendid stooling characteristics make the quality of the hay better than that

FIG. 10.—Rows of Sudan grass-sorghum hybrids, Arlington farm, Virginia, in 1912 (left); typical Sudan grass on the right.

from the sorghum-Sudan grass hybrids. One field of improvement which looks promising is that of resistance to disease. A number of the hybrid progeny grown at Arlington farm, Virginia, in 1913 were very much more resistant to the red-spot than others. These are being developed, in the hope that a strain which can endure the humid and warm atmosphere of the Gulf coast will be obtained.

SUMMARY.

(1) Sudan grass is closely related to the cultivated sorghums and is thought by some to be the progenitor of this group.

(2) It was obtained from Khartum, Sudan, in 1909.

(3) In appearance it is similar to Johnson grass, but it is somewhat more erect, taller, and has a broader leaf.

(4) It lacks entirely the underground rootstocks which make Johnson grass a pest.

(5) Two or three cuttings can be obtained from it under favorable conditions.

(6) The yields vary from 1 to 8 tons of cured hay per acre.

(7) Its seed habits are good, and large returns are now being secured from the seed produced.

(8) The seed of Sudan grass resembles very closely that of Johnson grass; therefore farmers should use seed only from regions free from Johnson grass.

(9) It promises to fill a long-felt want for a hay grass in the South, and will likely replace millets as a catch crop in the Central and Eastern States.

(10) It does not do well in sections having a high altitude, because the nights are generally cool.

(11) There seems to be a place for it in irrigated regions as a forage to mix with alfalfa hay.

(12) Chinch bugs and grasshoppers, among insects, and the red-spot disease are its greatest enemies.

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FARMERS' BULLETIN
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Contribution from the Office of Experiment Stations, A. C. True, Director, and the Bureau of Entomology, L. O. Howard, Chief.
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COLLECTION AND PRESERVATION OF INSECTS AND OTHER MATERIAL FOR USE IN THE STUDY OF AGRICULTURE.[1]

By C. H. LANE, *Chief Specialist in Agricultural Education*, and NATHAN BANKS, *Entomological Assistant*.

INTRODUCTION.

This bulletin suggests methods of collecting, preparing, mounting, and preserving insect specimens and other illustrative materials of various sorts which can be used by teachers of agriculture,[2] particularly those teachers who have not had special training along agricultural lines and who will therefore doubtless welcome specific information as to how to prepare materials needed for illustration and experimental use in the classroom.

WHAT MATERIALS SHOULD BE COLLECTED.

The nature of the material which the teacher should aim to collect will depend, of course, upon the character of the school and the class of work which is taken up, as well as upon the locality, the funds available, and the time which can be devoted to the work.

In general, the illustrative materials with which every school should be provided may be grouped into two classes, according to the uses to which they are to be put: (1) Museum specimens and samples which are to be kept permanently for reference, display, and strictly illustrative purposes only; and (2) working collections, which may be used for display and illustration, but the chief purpose of which is to supply the students with materials for class study and experimental use. For instructional purposes the latter is by far the more valuable, but a permanent collection of insect specimens and samples of various other materials may be very useful to any school, provided, of course, the specimens are accurately labeled and so preserved and mounted that they are readily available for examination. It is with

[1] This bulletin is intended for the use of teachers in rural schools throughout the country.

[2] Methods of collecting plant materials for this purpose are described in Farmers' Bulletin 586, which can be had on application to the United States Department of Agriculture, Washington, D. C.

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the solution of this problem that it is intended to deal particularly in this bulletin.

Materials for class use should, as far as possible, be fresh and in the natural state rather than in mounted form, and will therefore generally be collected just prior to the time they are wanted and put away only temporarily. No great degree of care or skill will, in general, be necessary to do this, but the preparation of materials for the permanent collection in a school museum often requires considerable technical knowledge and ingenuity in preparing and preserving the specimens and preparing convenient receptacles in which to keep them. This is particularly true where the means at hand are limited and the resourcefulness of the teacher must be relied upon to produce inexpensive methods and devices of home manufacture.

SOURCES OF THE MATERIAL.

In recent years many commercial houses, educational institutions, and Government bureaus have distributed collections of specimens and samples of various sorts to schools. Such collections are of great value, undoubtedly, and there is no objection whatsoever to schools securing materials from such sources whenever possible, so long as they do not rely upon these sources for all their illustrative material. It is, however, a much better policy to attempt, as far as possible, to have the pupils collect and prepare their own materials from original local sources, because of the possibilities for educative work involved in the process of gathering the various specimens.

Every community affords opportunities for collecting insects and other materials of vital importance in the study of agriculture, and the work of gathering these specimens will afford definite tasks upon which to center the interest of numerous field trips, so that the danger of aimless wandering, which so frequently makes this method of instruction devoid of practical results, may be minimized. The instructor who takes his class out into the field or orchard with the definite purpose to collect insects, for example, has the very best possible opportunity at the same time to teach, not only identification of the local insect species, but also useful facts as to their economic importance.

GENERAL SUGGESTIONS FOR FIELD WORK.

It is important that the pupils should be provided with notebooks and pencils for making complete and accurate records which should be kept for each specimen collected, in order to supply the data necessary for the proper labeling of the mounted specimen.

All work of this sort should be constructive and never destructive. Wanton destruction of insects, except those which are injurious to man or his crops, should be denounced and the young encouraged to watch the living insects and learn all they can of their habits.

SUGGESTIONS CONCERNING THE ARRANGEMENT OF MATERIALS.

When insects or other materials are collected for ordinary purposes of study and reference, it will generally suffice to arrange the specimens in their logical order, according to their scientific classifications. When, however, it is intended to prepare a set of specimens for an educational display, very interesting and attractive groups can be arranged to show strikingly the agricultural relationships of the particular insects in question. For example, a display might be centered about some farm insect pest which would show the insect in various stages of its development; specimens of the plants upon which it feeds, showing the injury it does to these plants; specimens of other insects which are hostile to it; and pictures of birds which prey upon it. Exhibits such as this take time to prepare, but they will prove enough more attractive than an ordinary collection to warrant the extra labor and thought involved in their preparation.

COLLECTION OF INSECTS.

WHAT INSECTS TO COLLECT.

When proper methods are followed, the collection of insect specimens can be made the basis of a great deal of useful instruction in connection with the subject of agriculture. There are numerous species that are really beneficial to the farmer, and these should, of course, be studied, but one generally thinks of insects as injurious to agricultural interests because of the great number of species that are annoying about the household or injurious to farm animals or farm crops. These insect pests should form the basis of most of the work of the class in agriculture rather than the butterflies and harmless insects of purely entomological interest, or even the beneficial species.

It should be the aim of the student of agriculture to collect and become familar with not only the adult forms of these insects, but also their larvæ and pupæ, since it is often in the larval stage that these pests are most injurious. Further, the pupil should become familiar with the life histories of the various species, since this will often furnish the key to the proper methods of combating the pests.

EQUIPMENT FOR INSECT-COLLECTING TRIPS.

The articles necessary for collecting insects are not very numerous and such as are most needed can be made by the pupils or the teacher with very little expense or trouble. The necessary equipment for an insect-collecting excursion should include collecting nets, killing bottles, a box containing some vials partly filled with alcohol in which to place specimens of larvæ and pupæ, a trowel for digging specimens out of the earth, a small hatchet for breaking open rotten stumps, some sheets of newspaper or other soft paper, size about

3 by 5 inches, for making envelopes in which to put delicate specimens of butterflies or moths, a small bottle of chloroform or gasoline, and a small hand satchel, haversack, or botanical specimen case, with a few small pasteboard boxes, such as pill boxes, in which to put insects after taking them out of the killing bottle. A small pair of forceps or tweezers will also be found convenient for handling some of the specimens, and a pocket lens will be a desirable aid for the study of the specimens in the field.

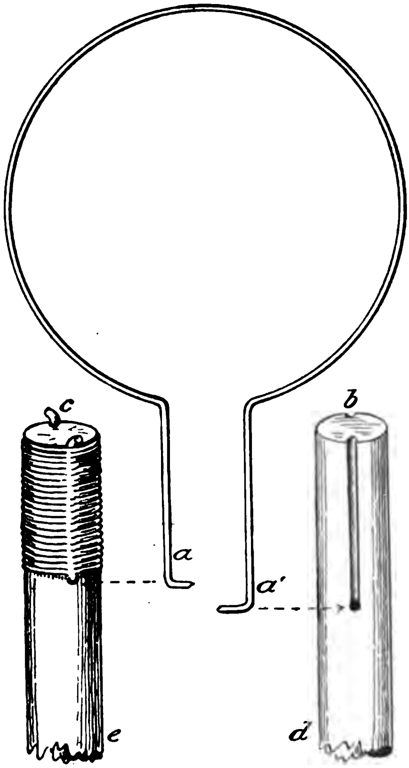

FIG. 1.—Homemade ring and handle: *a a'*, ring; *b*, stick showing grooves ending in hole; *c*, wire inserted in groove and hole, and wrapped with twine.

FIG. 2.—Net and killing bottle for insect collecting.

THE INSECT NET.

Anyone can make a satisfactory insect net (figs. 1 and 2). All that is necessary is a bag of thin material, a ring to support the bag, and a handle to be fastened to the ring. Bags are made of various materials. For beating through weeds and bushes it is best to have a bag of stout material, as twilled muslin or light duck cloth. For capturing butterflies and most flying insects a light net of cheesecloth or mosquito netting does very well for the beginner. The material should be such as not to stiffen or kink by use. Expert collectors often use bags of silk.

As a rule the length of the bag should be twice its diameter. The common size is 1 foot in diameter and 2 feet long. The bag is best if made to taper a little at the bottom, and the edges should be double hemmed (French seamed), so as to leave no free edge that may fray out. If the bag is of light material, it should be sewed to a band of stout muslin at the top. This band should be double and open at each end for the insertion of the ring, or else sewed on the ring. The ring may be of any heavy wire about the size of telephone wire. Bought rings usually have two or three joints to allow for folding, but although this is convenient for packing it is not important. The wire should be several inches longer than necessary to form the ring, the extra length bent at right angles, and the last half inch again bent at right angles. The stick or handle, about 2 or 2½ feet long, should be stout but not too heavy. A groove almost the size of the wire should be cut on each side near the end of the stick, ending in a hole; then the bent ends of the ring should be inserted in the hole and all wound tightly with twine, or a metal jacket slid over the ends to hold them in place. A longer and lighter handle of bamboo is better for collecting butterflies and dragon flies. It will be necessary to leave a few inches near the upper end of the bag unsewed in order that the ring can be inserted into the band. This part can be laced up with a string and the ends of the string tied to the handle. This will keep the net from slipping around on the ring.

For catching small insects a midget net of 5 or 7 inches in diameter is useful and can be made on the same plan as the larger one. The ends of the wire of the net can be inserted in a spool and a stick for the handle wedged in between the ends of the wire. This net is very handy for collecting insects from flowers and, in fact, for general collecting. The material for the bag of the midget net should be very light; white China silk lining is a good material.

For collecting aquatic insects a more open mesh or sieve net can be attached to an iron frame which is straight on one side and bowed up on the other. With cords attached to each side this may be thrown into the water and, after sinking to the bottom, drawn to shore. Dredging among the weedy or sedgy parts of a pond is especially productive of insects.

Many insects are attracted to lights, and a strong lamp with a reflector to throw the light upon a white sheet will serve to attract many insects, particularly on sultry nights. A mixture of sugar or molasses and decaying apples smeared on trees in the woods will often attract moths at night. A bull's-eye lantern is useful in examining these patches in the evening.

Many insects that occur on the trunks of trees may be captured easily by putting a small cyanid vial over them; thus one avoids handling the specimens. For collecting insects from the branches and leaves of trees, an inverted umbrella is the most useful implement. Hold it at arms length under the tree and jar the limb with a heavy stick. A sudden shock will dislodge many beetles and other insects that one would not have noticed upon the tree.

Cans or bottles sunk in the ground so that the top is even with the top of the soil and baited with meat, a dead mouse, rotten apples, etc., will be visited by various insects. Boards or pieces of bark left on the ground near the edges of woods and meadows will serve as shelters for a variety of insects, and if visited occasionally one will find many interesting specimens. Always turn back stones, logs, or boards after examining them so that they will continue to attract insects.

Fig. 3.—Poison bottles.

Many insects occur among dead leaves and moss. These may be sifted out on a white paper or cloth by the use of a sieve similar to an ash sieve but with a finer mesh. On collecting trips one should take along some empty pill boxes or larger tin boxes for caterpillars and other larvæ.

One must always be careful in taking insects from a net not to crush them nor rub the scales from the wings of butterflies and moths. Always handle specimens as little as possible.

THE KILLING BOTTLE.

After the insect is caught it is necessary to kill it with as little pain to the creature as possible and without damaging the specimen. Insects are so different from human beings and their sensations appreciated through much less perfect organs and their brains of such a very inferior nature that it is improbable they feel much pain through death. Many insects can have their legs and other parts broken from them without incapacitating them in any way, and many kinds have parasites living within them and feeding on their internal organs without their exhibiting any sign of pain; so there is no need to feel that we are harming helpless creatures by collecting insects. Still, for the sake of the effect on the collector, it is not well to gather nor destroy more than is necessary for this purpose.

Insects may be killed by a vapor of chloroform, ether, sulphur smoke, etc., but by far the best way is by the vapor of potassium cyanid. This potassium cyanid is a hard white substance which can be purchased at drug stores. It is a deadly poison. The cyanid may be broken into small lumps, put in a bottle, covered with a little dry plaster of

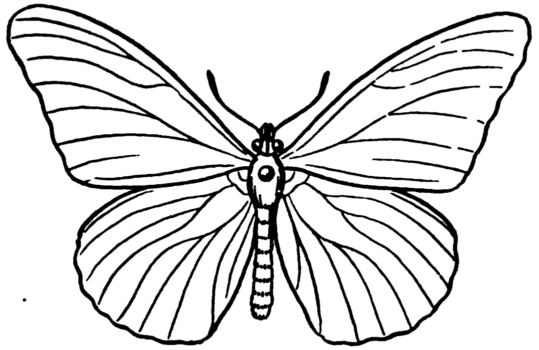

Fig. 4.—Method of pinning butterflies.

Paris, and then with a layer of plaster of Paris mixed with water so as to cover the cyanid about one-quarter of an inch. The bottle should be left open an hour or so to dry, and then kept

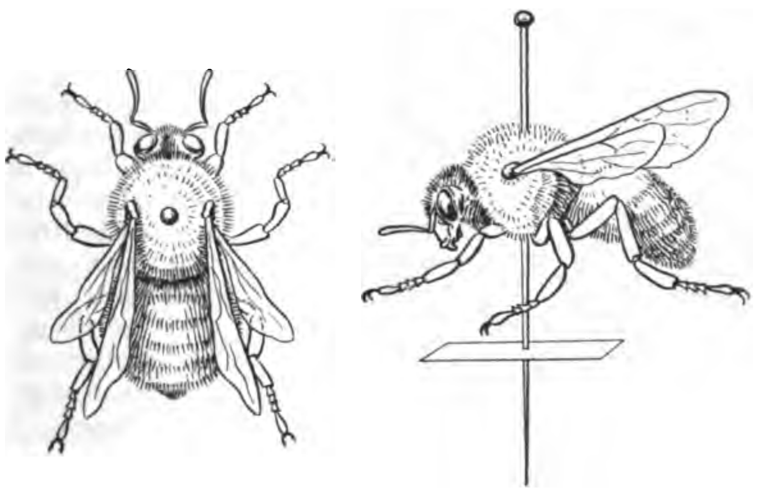

Fig. 5.—Method of pinning bees.

tightly corked so that the fumes of the cyanid will be strong enough to kill an insect in a few moments (fig. 3). A label with the word "Poison" should be pasted upon it. It is well to place some crumpled strips of soft paper in the bottle to absorb any moisture and to prevent the insects from shaking against each other. A well-made poison bottle will last several years. The bottle should be of thick glass, with a wide mouth and a tight fitting cork that does not set down too far for convenient handling. Some make a poison bottle by wrapping bits of cyanid in soft paper and covering all with blotting

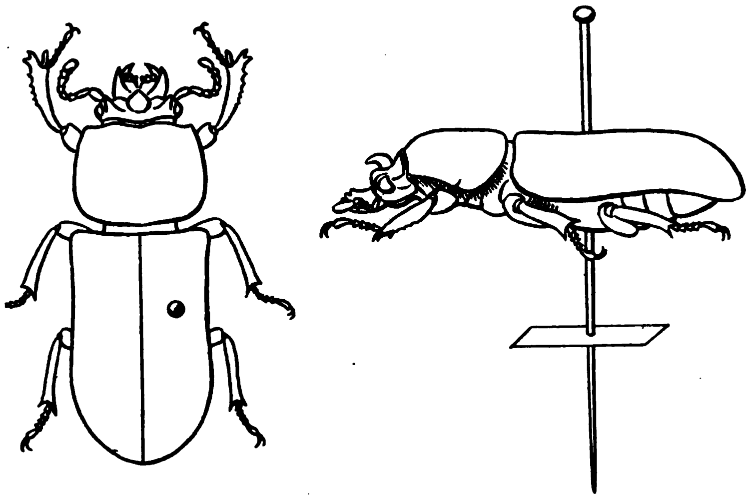

FIG. 6.—Method of pinning large beetles.

paper wadded down in the bottom of the bottle. This does very well for a small bottle but one should be very careful to have bottles of thick glass. Potassium cyanid is a deadly poison and the greatest amount of care must be exercised in handling it and if any is left over or a bottle broken it should be buried deeply in the ground. Poison bottles should not be left open in the room nor left where small children can get at them, and older children should be impressed with the possible danger. It is best that the teacher should have all the bottles returned after each collecting trip.

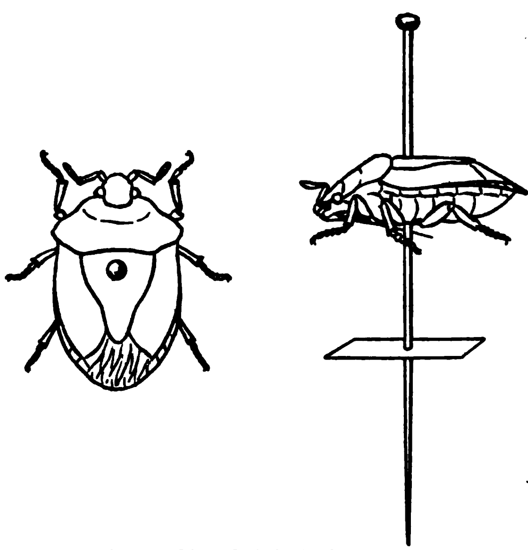

FIG. 7.—Method of pinning bugs.

Specimens should not remain in the poison bottle more than a day or two. In fact, insects with yellow markings should not be left in over night as the yellow will turn to red.

Most entomologists use many small cyanid vials or bottles of only about ½ to 1 inch diameter and 2 to 4 inches long. By taking several of these along on a trip, it is possible to keep insects of different sizes and kinds separate, for small flies are apt to get broken if put into the same bottle with large, heavy beetles. It is best not to put moths and butterflies in a bottle with other insects, as the latter are apt to become covered by loose scales from the moths or butterflies.

There is much less danger in handling insects than is popularly believed, since but few species are either poisonous or likely to injure the collector by biting or stinging. Insects like the wasps and bees will sting, of course, and a few of the larger beetles may pinch or bite, but these are generally well known and there are but comparatively few insects whose bites are poisonous.

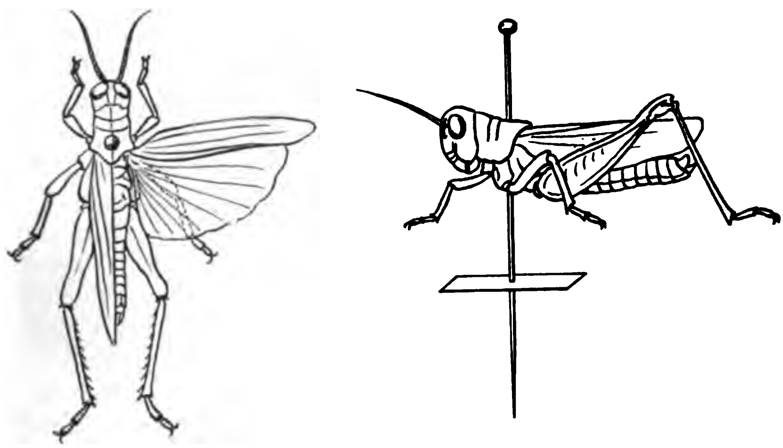

FIG. 8.—Method of pinning grasshoppers.

PINNING INSECTS.

Common pins are too large for most insects, and so entomologists use a longer and more slender pin. These pins can be purchased from dealers in natural-history supplies for a dollar or less per thousand. They are made bright, black, or japanned. The black pins cost a little more, but are much better for most insects, since the specimens will not verdigris. Verdigris is a poisonous green substance that may develop on an insect at the point where a bright pin goes through the specimen; it injures the specimen and eventually may destroy the pin. Some insects never verdigris, but those insects which feed on woody substances and many that live in the water are very apt to verdigris if pinned with a bright pin. The pins come in sizes according to number. No. 2 is a very good size for most insects, No. 1 for small insects, and No. 3 or 4 for the large ones. For use in school collections No. 2 will be the best size.

Most insects, like butterflies, moths, bees, and flies, should be pinned through the middle of the thorax (that part of the body to which the wings are attached) (figs. 4 and 5), but beetles should be pinned near the upper end of the right wing-cover (fig. 6), and true bugs through the scutellum (a triangular piece between the bases of the wings) (fig. 7). Grasshoppers are often pinned through the tip of the prothorax, a little in front of the base of the wings (fig. 8). The insect should be pushed fully two-thirds of the way up on the pin, and the collection will make a much better appearance if all the specimens are of an even height. Those specimens too small for a pin should be mounted on micropins (short pieces of slender wire having a pointed end) or glued on the ends of slender triangular pieces of cardboard called points (fig. 9). When the micropin is used, it is put into one end of a small oblong piece of cork and a large pin put through the other end of the cork. The points (about one-third inch long) may be cut from any fairly stiff cardboard. A pin should be inserted through the broad end, a little glue or shellac put on the point, and the insect laid upon it with the back outward, and its head away from the preparator when the point is to the left of the pin. Small beetles and true bugs are glued with the back up rather than on the side. It is very important that all specimens be correctly identified before they are permanently assigned to a place in the school collection. Entomologists usually have little two-lined labels printed in diamond type, giving the locality where the specimen was captured and a blank space for writing in the date of capture. These labels are put well up on the pin, a little below the insect, so as not to interfere with the legs. For school purposes labels may be written with a fine pen, care being taken to write them in a small and neat hand. Insects found eating plants should have a little label, giving the name of the plant, and the entomologist also usually places on a label the name of the collector of the specimen. Children should be impressed with the idea that carefulness in these little details counts in the value and usefulness of a collection. Additional information and aid along this line may frequently be had from the State agricultural college or experiment station or from officials of the State department of agriculture.

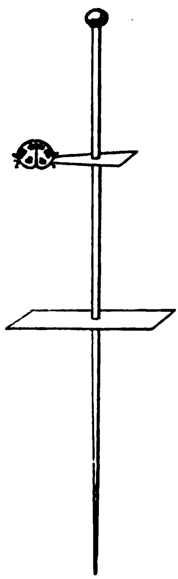

FIG. 9.—Method of mounting small insects.

SPREADING INSECTS.

Insects should be prepared and mounted as soon as possible after they are collected, for if they are left for any length of time the wings and legs will become stiff and easily broken, and it will be impossible to spread the wings as will often be desirable in order to give the specimen a lifelike and attractive appearance. If it should be impossible to mount the specimens until they have become rigid, they can be relaxed by placing them for a time on a piece of paper in a box partly filled with moist sand. It will be well to put a few drops of carbolic acid on the sand in order to prevent molding. After being left in this way for a few days the insects will generally be sufficiently relaxed to make it possible to mount them without great difficulty.

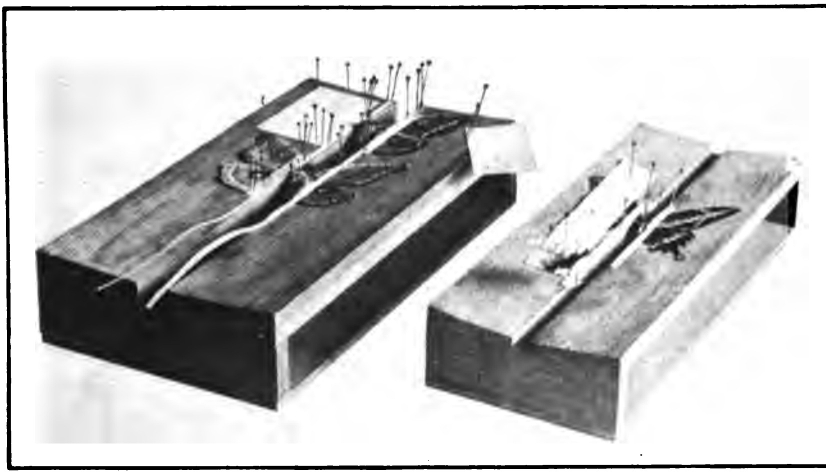

FIG. 10.—Spreading boards.

Butterflies and moths, dragon flies, and similar insects should have their wings spread out at right angles to the body. This is done by the use of a spreading board such as is shown in figure 10. Two strips of some soft wood, such as linden, white pine, or white wood, are fastened on low cleats resting on a bottom board. A strip of cork is fastened to the underside of the strips to cover the groove between them. The pin is pushed through the cork until the body of the insect rests upon it, and the wings are then stretched out on the boards by pulling them forward with a pin inserted near the front margin. They should be pulled out far enough so that the hind margin of the front wings will form a straight line. Then the wings should be held in place by strips of paper pinned down tightly at each end. The specimen should remain on the spreading board for at least a week, so that when removed the wings will stay spread and not relax to the normal condition. Care should be taken in placing the strips across the wings, so as not to rub the scales from the wings of butterflies and moths. With grasshoppers it has been customary to spread the wings of one side only.

BOXES.

If it is desired to keep the insects for several years, it is necessary to put them in a tight, dry, and dark box—tight to exclude other insects which would eat them, dry to prevent mold, and dark to preserve their colors.

FIG. 11.—Covered box for insect specimens.

There are two sizes of boxes commonly used by collectors. One is a box about 9 by 12 inches with a hinged top (fig. 11). These often stand on edge on a shelf. The other is a larger box or drawer about 15 by 18 inches with a removable glass top. These drawers are arranged to slide into a cabinet. Cabinets, with three or more drawers, that will be excellent for school collections, can be purchased from dealers. For the purpose of temporary study insects may be kept in any style of box with a cover. Cigar boxes will do for a time (fig. 12). The bottom of the box should be lined with some soft material, such as cork, peat, well-dried corn pith, or corrugated paper, and covered with soft paper. To prevent other insects from coming in and eating the specimens, a pinch of flake naphthalene or a naphthalene cone should be placed in each box. Within the box the specimens should be arranged, each kind by itself in a row. A label with the name of the insect can be placed behind the row of each species, or attached to the first specimen in the row.

In recent years a new mount has been developed for exhibiting insects and their life histories and it is most excellent for use in schools. It consists of a pasteboard box about one-half inch thick, the top having a glass cover (fig. 13). This box is filled, not too tightly, with cotton. The insect is spread out on the cotton, the top pressed down and held by pins. These mounts can be purchased from dealers

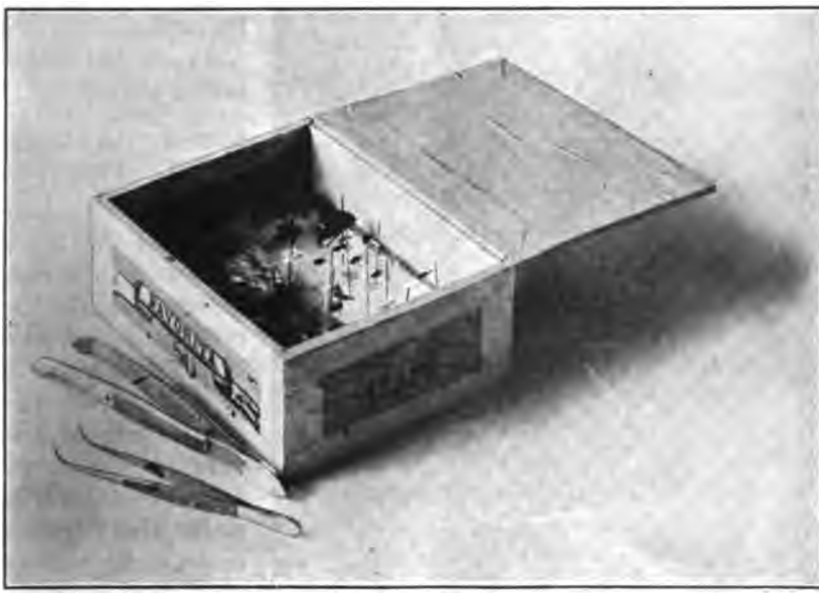

FIG. 12.—Cigar box for insects.

and are very useful for passing around in a class, or may be hung as pictures on the walls of the schoolroom. The eggs, caterpillar, chrysalis, and the adult, as well as a part of the plant eaten, can all be put in the same mount and thus exhibit the life history of the insect. To fumigate the specimens perhaps the best way is to place in the box with the specimens a small tin lid or other small shallow vessel and put into it about a tablespoonful of formaldehyde or of carbon bisulphid. The latter substance is inflammable and should not be handled near a fire. The fumes from both these substances are very annoying and disagreeable, hence it will be advisable to do this fumigating out of doors, or in an outbuilding, never in the schoolroom.

The specimens illustrating the life histories of insects will not be complete unless the larvæ are preserved, and it is often in this form that the creature is most injurious to crops. Furthermore, there are some soft-bodied insects, like the spiders, which can not be preserved dry. These specimens must, therefore, be preserved in fluids. A good fluid for this purpose can be made by mixing 10 parts of formalin (40 per cent formaldehyde), 100 parts 95 per cent alcohol, and 100 parts distilled or boiled water.

FIG. 13.—Series of specimens illustrating life history of a moth.

KEEPING LIVE INSECTS—BREEDING CAGES.

One of the most interesting phases of insect study is the rearing of insects. The simplest way is to collect the cocoons attached to various trees in the autumn, and the fine moths, red, brown, or pea-green, will appear the following spring. It is more instructive, however, to collect the larvæ or caterpillars and place them in a box where they can be supplied each day with the proper kind of leaves for food. By this means one can watch the caterpillars change their skins while they grow, and also note the change from the caterpillar to the pupa or chrysalis. Any box with a top of netting to prevent the caterpillars from getting out will be suitable. By putting moist sand in the bottom of the box, the food will keep fresh a longer time.

A very convenient and useful breeding cage is made by putting a lamp chimney in a flower pot (fig. 14), the top of the chimney covered with a piece of gauze or mosquito netting. With a saucer outside containing water the sand or earth in the pot can be kept moist so that twigs of the food plant will remain fresh for some time.

FIG. 14.—A simple breeding cage for insects.

It is interesting to keep ants in an artificial nest. A simple one may be made by taking a piece of board at least 1½ inches thick and about 12 inches square and making a channel 1 inch wide and ¾ of an inch deep all around the near edge. This channel should be nearly filled with water. On the center of the board put two pieces of glass about 8 inches square and between them a thin layer of soil or comminuted wood. Cover the top glass with a blackened board or tin. Ants placed between the plates of glass will excavate tunnels and if fed may be kept a long time.

If galls of insects are collected in the fall or winter many specimens will issue in the spring. Twigs of oak and other trees blown off in the fall or winter may contain beetles and if placed in a room the insects will issue and fly to the windows. In rearing moths or other insects one sometimes finds that instead of the expected specimen there appears a quite different insect. This is usually an Ichneumon or Tachina fly. The young of these live parasitically in the caterpillar and destroy it. These parasites should be saved and when possible the name of their insect host should be put on the label.

More extended directions covering special kinds of collecting can be obtained by applying to the United States National Museum, Washington, D. C.

COLLECTION OF ROCK AND SOIL SPECIMENS.

While an exhaustive knowledge of geology is not essential to the study or practice of agriculture, it is important that the student of agriculture should be familiar with the more important types of soils and the processes by which these soils are evolved from mineral or vegetable sources. For this reason the pupils should collect and study specimens of the more important rocks, such as granite, sandstone, and limestone, from which various types of soils are formed by decomposition. These rock specimens should be chipped with a hammer to a convenient size and shape for handling and storing, say into rectangular blocks about 2½ by 4 inches in area and 1 to 1½ inches thick at the center. Each specimen should bear a catalogue number or a label indicating the kind of rock and the place of collection. The label itself may be pasted on a smooth surface of the rock or the catalogue number may be painted on it and the description written in a book kept for that purpose. The specimens may be kept in boxes or in trays on cabinet shelves in the schoolroom.

Besides these specimens the pupils should collect, where possible, rock specimens showing evidences of the natural processes by which the rocks are decomposed to form soil. Thus, rocks bearing evidence of weathering, of glacial scratching, or the wearing effect of running water, should be collected and properly described.

To show the process of soil formation by the decay of vegetable matter, go into the forest where there is a deep layer of leaf litter and take up a section of the soil cover down to the mineral soil. Place this in a glass jar, preserving as nearly as possible the positions of the various strata—on the bottom the soft black mold or humus, above this the half-decomposed vegetable matter, and on top the fresh layer of leaves and twigs—thus showing the various stages in the formation of humus.

Collect specimens of all the types of soils found in the vicinity and classify them as sand, clay, silt, loam, or humus. Keep these in glass jars so that their textures and colors may be examined readily. Each jar should, of course, bear a proper label, indicating the type of soil it contains and the place where the specimen was obtained.

OTHER ILLUSTRATIVE MATERIALS.

COMMERCIAL FERTILIZERS.

It will be a good idea for the school to secure samples of commercial fertilizers sold on the local market, keeping these in small bottles, labeled with the name under which the product is sold, and, if possible, its composition.

MANUFACTURED PRODUCTS.

By way of illustrating the commercial importance of farm products interesting collections can be prepared to show the various ways in which these products are utilized in trade. Thus, a series of articles might be prepared to show the products which may be manufactured from corn, such as breakfast foods, corn sirup, cornstarch, corn oil corn rubber, commercial foods for live stock, paper made from cornstalks, cellulose made from the pith of the stalks, and numerous other articles. In like manner, the uses of other farm products, such as cotton, oats, wheat, and others may be illustrated.

LANTERN SLIDES AND PICTURES.

Nearly every well-equipped school nowadays has facilities for using lantern slides to illustrate special lessons on various topics. No subject presents greater possibilities for the use of slides than agriculture. Slides which will be of interest to agricultural students can be purchased from commercial firms or from other sources, or, if the school can not afford to own a set of slides, there are always opportunities to borrow or rent special sets for temporary use.[1]

Every school in which agriculture is taught ought to own a collection of pictures to illustrate the work. Photographic prints are, of course, the most desirable; but when these can not be obtained, half-tone cuts, or even line drawings taken from the pages of agricultural papers and from similar sources, can be used to advantage. In many schools either the teacher or some of the pupils will have cameras, and thus original photographs may be obtained for the collection. It is suggested that these pictures be mounted on good quality gray cardboard mounts of uniform size and filed upright, under convenient classifications indicated by guide cards, in a drawer or letter file. It is not advisable to paste pictures of this sort into a bound scrapbook, since in this form they can not be so readily used by the class.

Some of the kinds of pictures which should be collected are the following: Types of the various breeds of farm animals; views of good farm buildings and well-arranged grounds; good types of farm products, such as well-formed ears of corn; views illustrating the

[1] Lantern slides on agriculture and forestry can be purchased or borrowed to a limited extent for educational purposes from the United States Department of Agriculture, Washington, D. C. Applicants should write to the department for furthern information.

working of natural processes of importance agriculturally, such as soil erosion; views of different kinds of farm machinery and equipment; views illustrating experiments and demonstration field work carried on by the school. Especially interesting are pictures which show contrasts of good and bad farming methods. It will be found that a good picture collection of this sort will prove to be exceedingly useful.

CHARTS AND MAPS.

Much more use can be made of charts in the teaching of agriculture than is usually done. They can be used to record formulas and data which may be wanted again at some future time, but which are likely to be lost if placed on the blackboard where they may be erased. Thus, plans for the reorganization of farms of the vicinity may be worked out by the pupils and charted for future reference; schemes for proper system of crop rotation on these farms may also be charted; formulas for fertilizer compounds or spraying mixtures may be written on a chart and kept for reference; and drawings of various kinds, such as those showing the various cuts in a beef carcass, may thus be prepared for general use (fig. 15).

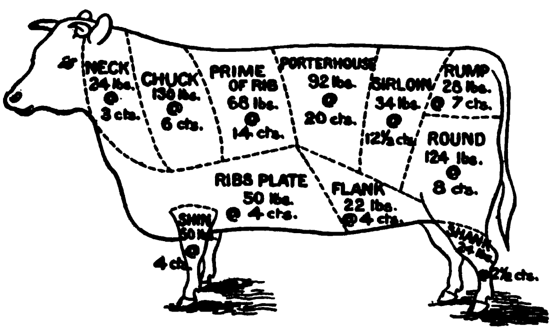

FIG. 15.—Chart showing cuts of beef.

A good chart can be made by the use of heavy manila paper cut into sheets of convenient size, such as 2½ by 3 feet, these sheets being fastened together at one end by nailing them between two pieces of lath. Screw eyes fastened in the ends of one of these laths with a cord tied to them will serve to support the chart on the wall.

Maps for use in the study of agriculture should be chiefly local in character. For most regions topographical maps and soil maps may be obtained. It will be well also to have a map of the forest land of the locality if possible to obtain one.

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U.S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN
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THE FARM KITCHEN AS A WORKSHOP.

By Anna Barrows.

INTRODUCTION.

The kitchen is the workshop of the home, for the greater part of the housework, particularly that which pertains to the family food, is carried on there. As in any other well-ordered workshop, it is essential that the kitchen be conveniently located with reference to the other rooms and conveniently built, that the necessary equipment be provided and so arranged that the various tasks of the kitchen may be performed thoroughly and rapidly and at the same time with the least expenditure of energy on the part of the housewife, and that suitable provision be made to secure the personal comfort and well-being of the workers.

According to the census of 1910 there are in the United States over 6,000,000 farms. On each of these there is presumably a farmhouse and a kitchen. In each of these 6,000,000 farm kitchens at least one woman is working. It is safe to say that in fully one-third of them the housekeeper has the assistance of relatives or hired helpers. A conservative estimate indicates, therefore, that there are 8,000,000 women working in the farm kitchens of the country, most of them many hours a day.

Improvement in the arrangement of the farm kitchen should, therefore, result in saving the energies of 8,000,000 people, and make their work less heavy and more enjoyable. The kitchen has been, and too often is at present, living room, dining room, wash room, laundry, entry from outdoors, and passageway to other parts of the house, as well as cookroom. Even in houses where it is possible to use the kitchen for the preparation of food only, it is very often far too large and is used for work which might better be done elsewhere.

The use, and consequently the size and location of the kitchen, varies greatly in different parts of the country. The present tendency, however, is toward small, compact kitchens used only for the preparation of food. Climate affects such matters; for instance, the

Note.—This bulletin is of interest to farm women throughout the country.

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detached or semidetached kitchen of the far South is there logical and desirable, since it means a cooler house.

Each housekeeper must, therefore, study her own conditions and decide whether it is best for herself and her household to make the kitchen a "general-purpose" room, or whether another plan is feasible and will result in more comfort for all.

There should also be cooperation between the housewife who is to live and work in the house and the architect who plans the house, especially with reference to the kitchen, that the important view of both may receive due consideration.

RELATION OF KITCHEN TO OTHER PARTS OF THE HOUSE.

While the kitchen is the center and workshop of the home, its work also extends more or less to other parts of the house. In planning or building a home, it is of greatest importance that the relation of the kitchen to the other rooms be considered. The kitchen work is most closely associated with the pantry, dining room, and the store room, cellar, or woodshed. These should be located as near and conveniently as possible to the kitchen so that the journeys which must be made so often between these rooms will be as short as possible, thus saving many steps and a great amount of energy.

Other parts of the house which are closely related to the kitchen, although to a less extent, are the entry, or other place where wraps are left; the toilet, where hands are washed; the laundry; the living room; and the bed rooms, where children must frequently be cared for. Wherever possible these rooms should be located within easy access of the kitchen.

The pantry should be so located that it is convenient to both kitchen and dining room, which means that it must be near or adjacent to both. To meet the latter condition, it is often located between the dining room and the kitchen, and is then designed to be used both for preparation of food and for the storage of food, food supplies, china, table linen, etc. If it is narrow in proportion to its length and located lengthwise between the two rooms, it does not very appreciably increase the distance which must be traveled from the kitchen to the dining room. Two pantries are sometimes desirable, especially when there is an abundance of help in the kitchen. One of these is generally used for the preparation of food and storage of food and supplies, while the other is used as a serving pantry and contains counter space, shelves, and drawers for the storage of dishes and table linen, and a sink for washing the dishes. In this case, the sink in the kitchen would be used for washing and cleaning meat, vegetables, and cooking utensils.

Space should be provided in the kitchen and within easy access of the pantry and dining room for the work table, sink, stove, and ice box. It is also desirable that provision be made for filling the ice box either from the outside of the house or the entry, so that the person filling it will not be obliged to enter the kitchen. This will save much mopping and cleaning. Refrigerators can be purchased which are fitted with a door on the side or back of the ice chamber, and an opening corresponding to this door may be cut in the wall of the house and the chest filled from outside. This opening should be fitted with a hinged window or door and provided in winter with a heavy screen, so that it can be left open and the ice chest kept cold for the storage of food. When this is done the window frame should be tightly joined to the refrigerator, so that cold air may not come into the kitchen as well.

A shed for the storage of fuel or other general storage room should be located within easy access of the kitchen and on the same level with it. A separate room should also be provided for laundry purposes wherever possible, and this should also contain a sink, so that those coming into the house from out of doors may have some other place for washing their hands beside the kitchen sink. A closet or some other convenience should always be provided in the entry for coats, hats, overalls, etc.

In order to obtain light from two directions and "cross ventilation" the kitchen must be located either on a corner of the house or in a narrow part where there can be windows on opposite sides. Whether the chief exposure shall be north, east, south, or west is a matter governed by individual preference and local conditions. A kitchen which receives the morning light is usually desirable.

It is also advisable, if possible, to locate the kitchen so that clouds of dust will not be blown through the open windows from the road. It is of even greater importance that the kitchen be so located with reference to the barn and other outbuildings that the prevailing winds will not bring unpleasant odors or flies from them.

There should always be one door from the kitchen leading out-of-doors, either directly or better through a short passageway, and also a direct communication between the kitchen and the dining room. To save steps the pantry should contain storage space for the dishes and linen used in the dining room and some of the dishes, towels, etc., used in the kitchen.

The doors between the kitchen, dining room, and pantry should be made to swing both ways, so that they may be easily opened when both hands are full. Such doors should have a glass panel so that persons approaching the door from opposite directions can see each other and avoid colliding, and they should also be provided with some form of door check so that they will remain wide open when so desired. A hook and staple will answer the purpose if one does not care to use some one of the ordinary commercial devices.

In locating the kitchen with respect to the other rooms it is much more desirable for sanitary, esthetic, and other reasons that, if a bedroom is needed on the ground floor, it be separated from the kitchen and dining room by a hall or wall.

THE MATTER OF FLOOR LEVELS.

The kitchen, and so far as possible, all of the rooms, pantries, and passageways into which the housekeeper is likely to go often from the kitchen should be on the same level. Steps between kitchen and dining room, or kitchen and porch, waste time and strength, are dangerous, and may be the cause of broken dishes, and what is worse, broken bones. The question of floor levels should, therefore, be kept in mind particularly when old buildings are being remodeled.

If for any reason kitchen, dining room, and storerooms can not be on the same level, let the kitchen be where most light and air are available.

Basement kitchens are undesirable because the dampness, poor ventilation, and lack of light, which are apt to prevail in such rooms, may affect the health of the worker and favor the activity of bacteria and molds which cause the spoiling of food. A basement kitchen very often means a difference in floor levels of dining room and kitchen. If, however, there must be a basement kitchen, a dumb-waiter or "lift" is an important and useful addition.

A refrigerator, a cold pantry, window box, or food safe should be on the same floor as the kitchen, instead of in a cellar, to save time and labor and for sanitary reasons. Where this is impossible a dumb-waiter connecting with the cellar is again desirable.

SIZE OF THE KITCHEN.

In determining the size of the kitchen the housekeeper must, first of all, make a decision with regard to the uses to which the kitchen is to be put. If the meals are eaten in the kitchen a larger room is required than if it is used for cooking only. A small kitchen may serve on a farm located near a town where supplies and cooking utensils may be purchased as desired and where dependence is not placed on farm helpers who must of necessity be inmates of the farm house, while a much larger kitchen is required on a farm, remote from the base of supplies, where many people, including farm helpers as well as the farmer's own family, must be fed and where provision must be made for the storage of large amounts of supplies and a much greater number of cooking utensils. Thus, the location and character of the farm, as well as the size of the family, are factors in determining the size of the kitchen, owing to the provision which must be made for storage in many cases.

On the large farm during harvest the feeding of numbers of extra men, or extra work, such as fruit and vegetable canning in the farmhouse, cause a temporary demand for a large kitchen. It is better, however, to have an extra kerosene stove and to establish a temporary kitchen and dining room on a porch, in a shed, or in another room for such occasional use than to have a large kitchen and to travel over its great distances all the year around.

FLOORS, WALLS, AND CEILINGS.

All surfaces in the kitchen, whether on floor, walls, or ceiling, should as far as possible be plain and free from cracks, ridges, moldings, and raised forms of ornamentation, for such places not only collect dust and dirt and thus increase the difficulty of keeping a room clean, but also may harbor ants, roaches, and other pests. The materials used in the kitchen, on either walls or floor, should be nonabsorbent and easy to keep clean.

FLOORS.

Unfinished wooden floors can be kept clean only by frequent scrubbings. Even hard wood floors are likely to show spots and stains in spite of such scrubbings, and the softer woods become rough and splintered. The roughening of soft woods can be prevented to a certain extent by the application of paint, and hard woods can be made less absorbent by the application of oil and special commercial preparations. Hard woods, for instance Georgia pine, are, therefore, to be considered among the more desirable floor coverings. Unless well seasoned before being put down, any kind of board will shrink, leaving large cracks. These may be filled with putty or with one of the commercial preparations for this purpose.

Floor coverings, such as carpets and mattings, which hold dust and dirt, are unsuited to the kitchen. Oilcloth is cheap and easily cleaned, but wears out quickly. Linoleum, a material made of cork or wood pulp pressed in linseed oil, although the first cost is large, as compared with oilcloth or paint, is relatively durable, comfortable for the feet, and easily kept clean. Another advantage is that a single piece may be cut to fit the floor, thus avoiding crevices. It may be protected by placing small mats where the most wear comes.

Whatever the material of the floor, constant scrubbing and the excessive use of soap and water tend to wear out its surface. Much care should be taken, therefore, not to drop food materials on the floor. One should cover with pieces of paper the places where food is likely to be dropped or grease to be spattered. A soft brush or dust mop will keep a floor in better condition than a broom and render mopping less frequently necessary. A dish mop of hotel size, kept always in a convenient place and used dry to remove drops of water or other liquids accidentally spilled, will save frequent scrubbing of the entire floor, and when dampened and wrung nearly dry can be used to remove spots or dust. If so used it will often prevent dirt from being carried from one part of the room to another.

WALLS AND CEILINGS.

The commonest and most generally satisfactory material for walls and ceiling of the farm kitchen is plaster. The lime used should be properly slaked to prevent the development of cracks and blisters and injury to the surface finish. For the same reason, freshly plastered walls should be allowed to dry thoroughly before the finishing surface is applied. Instead of plaster, some of the various composition boards may be used. They may be left unfinished or they may be painted or papered and varnished. The joints between the boards should be covered by narrow battens, making tight joints. Steel wall and ceiling coverings, although durable, should be kept well painted to prevent rusting by steam. The woodwork should be shellacked or painted. A better surface results when a coat is applied every year or two than when several coats are applied at once. A final coat of enamel paint or outside varnish is desirable for such portions of the woodwork as need cleaning most frequently.

The most desirable finish for walls and ceiling is one that will not peel off or crack and that can be easily washed or very cheaply and readily renewed. For walls a good paint gives general satisfaction. For the ceiling the most satisfactory finish is a coat of whitewash or one of the good commercial substitutes for it, which should be renewed annually or biennially. Such finish used on walls can be easily renewed.

Wall paper, unless varnished, is very easily loosened by the steam from kettles. A wall covering resembling oilcloth is somewhat more expensive, but it is more durable, and has a smooth washable surface. A damp cloth on a broom or a large sponge in a mop holder will serve, with an occasional washing, to keep this or a painted surface clean. Tiles and vitrified brick, well glazed and matched, afford an excellent wall surface, but they are costly. Metal tiles are cheaper and nearly as satisfactory.

The best color or tint for the kitchen walls is determined by the location and lighting of the room. Light colors are preferable for dark rooms because they reflect and diffuse the light into darker portions of the room, while dark colors absorb a much larger proportion of the light. Where the principal exposure is toward the south, greenish grays are desirable, but if toward the north or east, with little opportunity for sunshine, the light yellows or creams are better. Two shades of brown often give a satisfactory finish.

LIGHTING, VENTILATING, AND HEATING THE KITCHEN.

The housekeeper has to spend many hours a day in the kitchen, and sufficient light and ventilation are necessary not only to conserve her health, but to enable her to perform her work most efficiently. The kitchen should, therefore, have a generous number of windows, which provide both light and ventilation. In general, the higher the windows the more effective they are for providing light and ventilation. The air of the room rises as it becomes heated and to let it escape there should be at least one opening close to the ceiling, which may be secured by extending one window to the top of the room and by having its upper sash easy to lower and to raise (as all sashes should be). A window pole with a right angle metal top is a great help in lowering and raising windows. When the carpenter is working on the house a supply of these should be made and kept on hand for they will frequently be needed.

Instead of a window running to the top of the room, small windows may be placed near the top. To save space these may be over cupboard, table, or sink. It is often well to give these high openings the form of transoms which tip instead of move on pulleys, or of casement windows which swing on hinges like doors. Special arrangements (usually pulleys or other commercial devices) must be provided for opening and closing these.

In a room where cooking is done there can hardly be too many windows. It is, perhaps, less expensive and certainly more satisfactory to cut a window than to buy a hood for the range for carrying away smoke, odors, etc. Glass panels in doors allow light to penetrate into dark places—closets or passageways. Glass transoms over the doors may be made to furnish both light and ventilation in such places. If there is considerable danger of breakage, wire glass should be used, and frosted or other translucent glass can be selected when it is desirable to cut off the view, or some of the substitutes for stained glass may be applied to common glass for this purpose.

In the Northern States during cold weather good ventilation may be secured by placing a board, which is as long as the width of the window and any desired width, beneath the lower sash of the window and shutting the lower sash upon it. This arrangement will admit air between the two sashes without drafts. (See fig. 1, p. 8.)

Very good ventilation without great loss of heat may be obtained by use of window screens covered with cotton cloth. These have the advantage of allowing the outside air to enter without producing a draft, and they also keep out dust and dirt. The window of the pantry or storeroom which is to be kept open in winter might well be covered with these screens. The cloth may also be stretched across the window and fastened with thumb tacks or ordinary large-headed tacks, or brass rings may be sewed to the corners and slipped over nails or hooks in the sides of the window frame.

Window shades or blinds are necessary at sunny windows. At least one window should be equipped with an adjustable shade which can be pulled over either the upper or lower sash or both. Heavy window draperies are not suitable in a kitchen; if there are any curtains they should be plain and of inexpensive cotton material, so that they can be easily washed and frequently renewed.

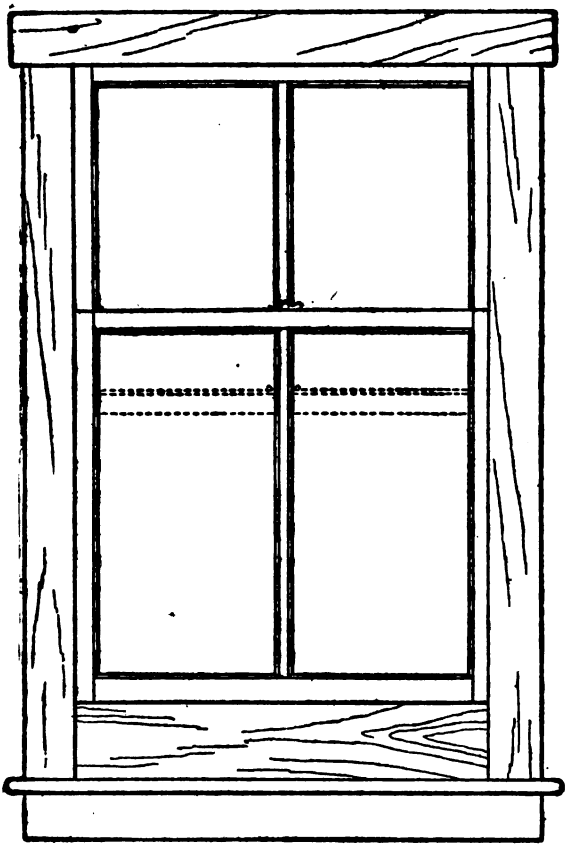

FIG. 1.—Ventilation without drafts secured by placing a board beneath lower sash of window.

Some of the popular styles of architecture require windows having many small panes of glass to each sash, but such windows are more difficult to clean than those having one or two large panes.

Owing to the heat given off into the room while food is being cooked, the kitchen is more often too hot than too cold. However, in the cooler parts of the country, especially where houses are old and the walls are full of cracks or the windows are loose, the problem of heating the kitchen in winter is greatly simplified if means are taken to keep the cold air out and the warm air in. Various means of accomplishing this purpose are chinking up the cracks with mud, mortar, plaster of Paris, putty, or commercial crack filler, tacking strips of cloth or weather strips around doors, windows, and over cracks, and banking the foundations (which are generally porous and full of cracks in the older houses) with earth, dry leaves, hay, straw, etc. It is well to attend to these matters in the autumn.

Double or storm windows are an advantage in cold regions, especially on cold sides of the house, as they save fuel by keeping out much of the cold air which would otherwise come in through and around the windows. One or more of the double windows in each room should be provided with a slide, which can be opened when more ventilation is desired. Storm windows, in a large measure, prevent the windows from becoming coated with frost and not only help to keep the house plants, which are often kept in the window, from becoming frostbitten, but tend to improve the lighting of the room. They should be fastened in place with screws and screw eyes, with hooks and staples, or in some similar way, so that they may be easily removed in summer, and should be fitted to the windows and then numbered to correspond with them, so that they may be easily put in place when needed.

STORM PORCHES.

In regions where the winter is severe storm porches prevent a great deal of cold from coming in when the kitchen door is opened and can be used to good advantage on the farm. The walls, sides, and roof should be tightly made of matched boards, should fit closely together, and, if fastened together with screws, they may be easily taken apart in the spring and stored until fall. A window should be provided in the door or in one side to admit light. A good plan is to have the storm porch consist of a permanent light wooden framework to which the solid sides can be screwed. These can be replaced in summer with fine wire screens and the solid door with a screen door. The doorway into the house should also have its screen door. This will secure the double screening of the kitchen or other outside door, which is so desirable as it is much more efficient than the single screen door in keeping out flies. Such a "screen porch" is particularly desirable in the warmer sections of the country where the "fly season" is long. Where a storm porch is desirable but not feasible, an extra door of matched boards attached to the outside of the door frame answers the purpose, although it is less convenient.

THE SCREENED PORCH.

For summer in the Northern States and for all the year use in the warmer regions of the country, there should, if possible, be a screened porch opening off from the kitchen on the side which is not exposed to the sun during the hottest part of the day, where in warm weather much of the kitchen work may be done. There are some advantages in having the screened porch on the side toward the garden and opening into it. But, on the other hand, if it is completely screened, has no outside door, and no openings, excepting into the kitchen, and is large enough to offer a place where dish towels and mops can be dried, supplies stored, and garbage and other forms of waste kept temporarily, the number of times the outside kitchen door must be opened will be reduced and thus the danger of letting flies in will be lessened. In cold regions the screens can be replaced in winter with window sash or solid sides and the porch made use of as an extra storeroom.

SCREENS.

All windows and outside doors should be screened. Cloth or wire netting tacked on the outside of windows will serve, but it is much better to have wooden or metal frames the full size of the windows covered with wire netting having 16 meshes to the linear inch. This will protect against both flies and mosquitoes. Each screen should be fitted to its special window and both screens and windows should be so numbered that they may be matched up without difficulty. Springs, a weight and pulley, or other self-closing devices are very desirable for screen doors which should close tightly, and preferably be latched. Otherwise they are useless and make it much harder to get flies out than if there were no screens.

PLACING OF PERMANENT EQUIPMENT IN THE KITCHEN.

In planning or remodeling the kitchen, the work table, ice box (or other place for the storage of food supplies), dish cupboard, stove, sink, and set tubs [1] (if any) should be so located that the tasks in the kitchen may be performed most conveniently and with the least expenditure of time and energy, which means they must be near together, but must not interfere with free passage from one to the other. Upon the location of the last three in particular depends to a certain extent that of the chimney and water pipes.

The greater part of the work done in the kitchen is that associated with the processes of preparation and service of the food and of cleaning up. These processes consist in collecting utensils which are to be used at the work table; gathering the supplies from cellar, pantry, or ice box; preliminary operations at table or sink, such as mixing, washing vegetables and fruits or meat, cleaning poultry or fish, etc.; cooking; and disposal of the food on the dining table or else in pantry or ice box for future use. The processes of cleaning up involve disposal of surplus food; putting away of equipment not requiring cleaning; collection and disposal of waste and soiled dishes; washing dishes; and

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[1] U. S. Dept. Agr., Farmers' Buls. 317, 342.

the restoring to their proper places of the clean dishes and cleaning utensils.

In performing these various tasks certain distances must be traveled, some of them much oftener than others. For instance, it is necessary to go from the ice box to the cooking table or pantry, from cooking table or pantry to the stove or sink, and in some houses from the pantry to the cooking table very many times. It is evident from this that to shorten the distances traveled the ice box, table, sink, and stove should be placed close together and at the same time in close proximity to the dining room and pantry. Where there is no dining room these should be placed together near the pantry in one end of

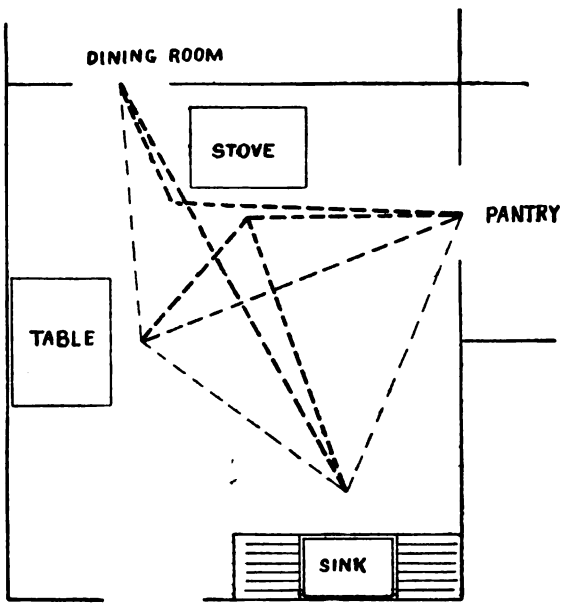

FIG. 2.—Large kitchen in which the inconvenient arrangement of sink and table makes it necessary to walk long distances in preparing and serving a meal.

the kitchen, which should be used strictly for the preparation of the food, the other part of the room being reserved for eating.

Figures 2 and 3 illustrate how time and strength may be wasted in the various steps of these processes by the improper location of the pantry, stove, table, and sink with reference to the dining room. The dotted lines represent distances traveled in the preparation, service, and cleaning-up processes of the meal. Those traveled most frequently are indicated by heavy lines. Figures 4 and 5 illustrate how the distances illustrated in figures 2 and 3, respectively, may be materially shortened and time and labor saved by bringing the stove, table, and sink near together in one corner of the room near the pantry and dining room.

THE KITCHEN AS LAUNDRY.

Sometimes a kitchen is used as a laundry, but from the sanitary standpoint it is wiser, expense permitting, to have separate rooms for these two purposes. However, on account of extra expense for plumbing, fuel, and extra labor, it may be desirable to install two set tubs close to the kitchen sink. These are generally covered when not in use and thus serve as a sink table.

In cases where set tubs are out of the question, it is sometimes possible to have a low sink with a drain and to place ordinary wooden tubs over this. Each tub should have an opening in the bottom,

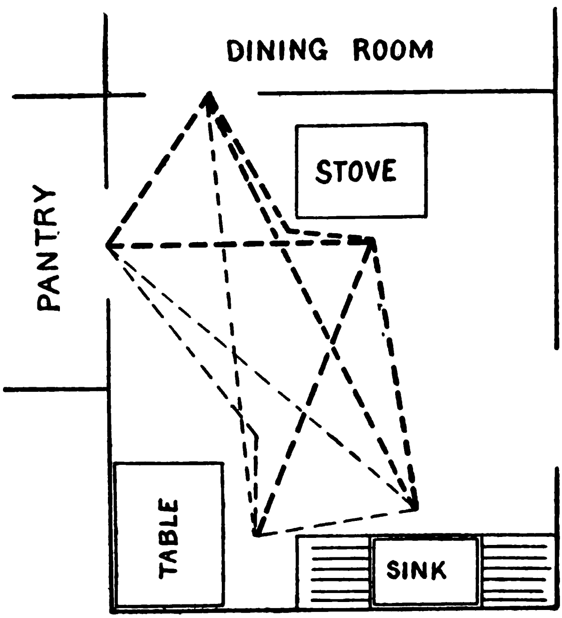

FIG. 3.—Fairly small kitchen in which distances traveled in preparing, serving, and cleaning up after a meal are unnecessarily long due to inconvenient location of sink and table.

fitted with a cork or rubber stopper for the easy removal of water. A piece of hose attached to the faucets will serve to fill the tubs and, where there is no water heater, to fill kettles or boilers on the stove. A hose with a funnel on one end with a wire to attach it may often be made to serve the same purpose where a kitchen pump is depended upon as a water supply.

PROPER HEIGHT OF THE WORKING SURFACE.

The top of the stove and work table, the bottom of the sink, or any other surface upon which a given task is to be performed should be at such a height from the floor that the housewife can work easily without being obliged to stoop or raise her arms unnecessarily. If the surface is too low, as is so often the case, the worker must continually raise and lower the upper part of her body with each motion, while if it is too high she must lift her arms in such a way as to bring unnecessary strain upon the muscles. Both of these mean a needless waste of energy and greatly increase the labor connected with kitchen tasks. They can be avoided by raising or lowering the table, etc., as need be, which, in many cases may be done by placing the table upon blocks of wood preferably hollowed on top to prevent the legs of the table from slipping (fig. 6), or better, by having the table legs spliced. The legs of the table may be easily

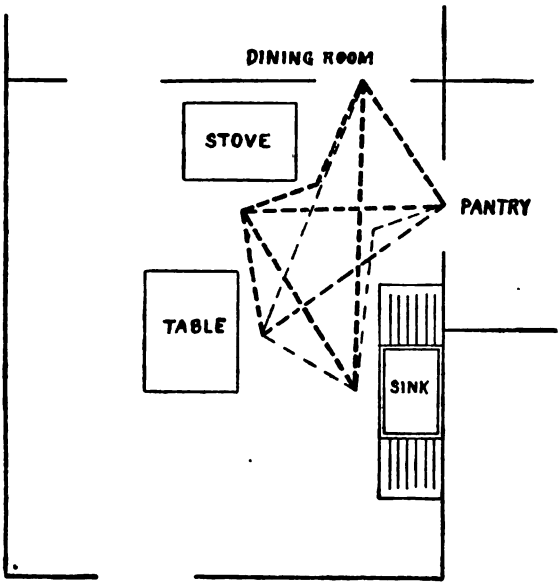

FIG. 4.—Same kitchen as shown in figure 2. The distances traveled have been reduced and many steps saved by cutting another door into the dining room and by moving the table and sink nearer to stove and pantry.

cut off if it is too high. Likewise the stove can be blocked up or placed on shorter legs as may be needed.

It would be a great advantage to have kitchen tables made so that the top can be raised or lowered at will, since any given height is not most convenient for all kinds of work. For instance, in using an egg beater or a chopping bowl, a lower table is more convenient than would be one of the right height for kneading bread. Several tables of different heights are convenient, as each task can then be performed on a table of the most convenient height. Where this is not feasible, a table for general use should be selected of such height that the majority of the kitchen tasks may be performed upon it with a minimum of stooping or unnecessary muscular strain. In general this should be from 32 to 36 inches high, but the height will, of course, vary with the height of the worker, who should therefore test the matter for herself by trying the same task for a half hour or more on tables or packing boxes, etc., of different heights and determine at which height she can work without strain or undue fatigue. Tables for ironing or other processes where considerable pressure is necessary should be somewhat lower than the table for general use, in order that the weight of the body may be utilized in obtaining the pressure. They should, however, not be so low that the worker will have to bend over too much.

Most sinks especially are too low for even a woman of medium height to wash dishes without stooping, and it would be better to have a box stool for a child or short person to stand on than to oblige a tall woman to stoop to a low sink. The bottom of the sink should not be less than 30 inches from the floor, and 31 inches is better for a woman of average height. The "built-in" sink can be placed at the proper height as easily as any other. If there is no way to raise a sink which is too low, the dish pan may be raised to a convenient height by placing it on a rack or some other utensil.

THE STOVE—ITS LOCATION AND CHOICE.

Before choosing a stove or range its proper position in the kitchen should be determined. Room must be allowed for the hot-water boiler (if there is one), and it need not necessarily be placed at the side of the range, but may be suspended from the ceiling and need not necessarily be close to the range if space is limited. It must, however, never be placed below the level of the range, as the water will not circulate and heat satisfactorily under this condition. As the boiler gives off considerable heat it may be economical sometimes to put it a little distance from the stove and where this heat may be utilized. Allowance must also be made for opening the oven door readily. The oven is usually on the right and the fire box on the left, but in some stoves this is reversed. Where room is limited an oven door which opens downward instead of either to right or left is a convenience.

The floor under the stove or range should be made of or covered with some fireproof material. A built-in base of cement or brick is best, but when this is impossible some one of the composition materials, made of a mixture of cement and asbestos, which can be bought by the square foot, will do very well as a protection for the floor and also for the walls back of the stove. Sheets of zinc or galvanized iron smoothly laid and securely tacked are useful for these purposes.

The kind of cook stove chosen will also be determined largely by the available fuel supply; its size by the amount of work to be done with it. It should be of reliable make not only to insure good construction, but also to make sure that parts can be easily renewed as needed. A larger range than is needed for cookery is often selected in many homes where the kitchen fire is used for cooking and for heating the house in cold weather. It would be wiser in many cases to use a liquid fuel stove in summer for cooking purposes or else to have a small range for cooking and an additional heater for warming the kitchen in winter, thus saving fuel and avoiding the overheating of the house in summer. In houses which have a furnace or other central heating system, the kitchen should be provided

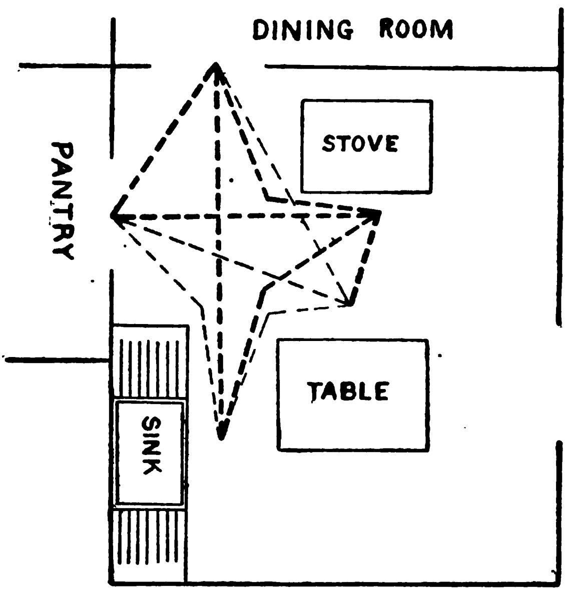

FIG. 5.—Same kitchen as that shown in figure 3. Steps have been saved by putting the sink and table in more convenient locations with respect to pantry, stove, and dining room.

with a radiator or hot-air register for heating purposes. It will then be possible to use a liquid-fuel stove for cooking in winter as well as summer, and the price of a kitchen stove or range may be saved if desired, as both types of stove will not be needed.

THE LOCATION OF THE KITCHEN SINK.

The place of the sink, like that of the stove, is often apparently settled by the builders of the house without reference to the housekeeper's convenience and the position of the other kitchen furniture. If there are water pipes or drainpipes to be considered, their position can be more easily changed than that of the chimney, and should be so changed if convenience demands. The sink is usually placed with its long side against the wall, but this is not always the best plan. Some modern houses have the sink near the middle of the kitchen, so that it may be used from both sides instead of from one only. Or, it may be convenient in some rooms to have the end against the wall and the faucets there, if there is running water in the house, as there should be if possible. This reduces the danger of breaking dishes by hitting the projecting faucets. This danger may also be reduced by attaching short pieces of rubber hose to the faucets. The sink and the stove should be near together to save a long journey across the kitchen when a kettle must be filled or emptied, but not so near that the heat will be oppressive when working at the sink. It should be where there is good light, but not across the main window of the kitchen, and should always be placed at a height most convenient for the worker, as discussed under "Proper height of the working surface."

The size of the family and of the kitchen must determine the size of the sink, but a short sink with ample table and shelf room near it may be more convenient than a long sink. Two smaller sinks, one for the table dishes near the dining room and the other for general use in the kitchen, are very convenient.

The material of the sink should be the best available, nonabsorbent of grease as well as of moisture, and there should be no cracks or square corners to increase the work of keeping it clean. A wooden sink and sink spout, even when they receive an annual coat of paint, will absorb moisture and grease which attract insects, and are likely to be swarming with bacteria and to "sour" and have an unpleasant odor. Even drain boards of wood are not recommended unless they have a waterproof finish of oil or paint. If a wooden sink is necessary, it is better to have it metal lined, providing the sheets of metal, which is usually tin, zinc, galvanized iron, copper, or lead, are soldered where they are joined and all parts of the sink, including the tops of the sides, are covered with the metal, so that there is no chance for the wood to absorb moisture. Another plan is to have a cement sink built into a wooden frame and lined with sheet copper or tin.

Iron sinks of good quality are superior to wooden ones, since they do not absorb grease or moisture and are durable. They are easily kept clean if smooth (and they will soon wear smooth), but they have the disadvantage of neither showing dirt nor proclaiming their cleanliness. Unless the front is protected by a strip of wood, the dresses and aprons of the worker are likely to become stained with iron rust. A soapstone or a slate sink is durable, but sometimes becomes uneven with wear, and if this happens much brushing and scrubbing are required to remove the sand and grease which gather in the depressions when vegetables are cleaned, dishes washed, etc.

Like iron, they do not show whether they are clean or not. Enameled iron and porcelain sinks are probably the most satisfactory, since they are smooth and may be easily kept clean and last well with careful use, but they are more expensive than some of the other kinds. Perhaps the ideal plan is to have a porcelain sink for the tableware in the kitchen or the pantry near the dining room, and an iron or soapstone sink for the heavier kitchen ware.

The double sinks, with one basin for washing and another for draining dishes, are very convenient, but unfortunately they are relatively expensive. A small sink with a rubber stopper for its escape pipe may be used as a dish pan when two sinks are used.

The wall behind the sink should be covered with some material which will not absorb water or grease and which is high enough to hold the faucets if there are any. A solid back of the same material as the sink reduces the number of places which collect dirt and attract insects. Sheet zinc may be used when a solid back can not be obtained, but it must be carefully fitted and held in place with plenty of neatly set nails.

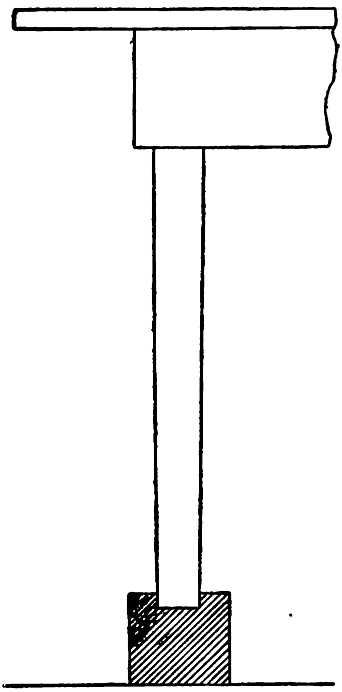

FIG. 6.—A table which is too low may be raised to the correct height by placing under each leg a block of wood, the top of the block being hollowed out to prevent the table from slipping.

It is important that the sink stand true and level, for if it does not there may be a point lower than the drain where water can settle. Many good sinks are built with a slight slope toward the drain. In case water is scarce and it is difficult to flush the drainpipe properly after the sink has been used, it may be better to wash dishes on the table and carry away the waste water. Openings to all pipes in tubs and sinks should be screened to prevent clogging of the drains.

The plumbing should be easy of access, and, therefore, it is better that there should be no closet under the sink. Hooks or shelves under the sink or near it will accommodate everything usually kept in the dark, often musty, "sink closet" of older kitchens. A "sink closet" can be kept sweet and clean, but it means extra work to do it. It is far wiser to have things in sight and in order than to have the extra work of keeping the "sink closet" clean or run the risk of having it an untidy place, which is no better just because it is out of sight. If there is a shelf under the sink it should be from 4 to 6 inches narrower than the sink and at such a height that one can easily clean the floor under it.

There should be a wide shelf or drain board on each side of the sink on a level with the rim of the latter, one to receive soiled dishes and the other clean ones. Some housekeepers have these covered with zinc, but, as in all other places where it is used, the metal must be neatly fitted and closely fastened down so as not to leave any chance for loose, rough edges, or to provide breeding places for insects or a lodging place for grease and dirt. If there is no place for permanent shelves, sliding or hinged shelves may be used. A right-handed person usually holds the dish in the left hand while washing or wiping it, and the dishcloth, dish mop, or towel in the right hand. It is convenient, therefore, to have the dishes move from right to left as they pass from dish pan to rinsing pan, and from rinsing pan to drainer and tray. This should be kept in mind and a drain board placed at the left of the sink.

SHELVES, CLOSETS, ETC.

In planning the storage places in the kitchen and pantries, the main factors to be considered are to keep each article near the place where it is most frequently used, to place the closets, shelves, and drawers where they are easily accessible and easily kept clean, where they will not be in the way, and where, as far as possible, they will utilize space otherwise wasted. To insure cleanliness they should be made of good wood, free from holes, knots, or other roughness likely to catch dirt and harbor insects. A further help in making shelves easy to clean is to leave a small space, say half an inch wide, between the back edge of the shelf and the wall.

Corner closets furnish an excellent method of utilizing space often of little value in the room otherwise. The triangular space is not very convenient for dishes, but serves well for a broom and cleaning closet. Narrow shelves sometimes economize space better than wide ones, for all the articles on them can be easily reached, whereas on the wide ones either part of the shelf room is wasted or the things in front must be moved to get at those behind. A shelf not more than 4 inches wide will conveniently hold spices, flavoring extracts, baking powder, and materials of this kind. Fitting deep shelves with shallow boxes or "trays" (light wooden boxes with sides about four inches high and with a knob or handle on the front end so they can be conveniently moved) is often worth while. These shallow boxes can be filled with bottles, cans, and other small articles neatly arranged. To take out the tray, select the article one wishes, and replace the tray is much more convenient than moving a large number of things about on the shelf until one finds something which may be at the back of it, and leaves the articles in much better order. Such a device as this (and it can be made at home) has been tested and proved its usefulness.

It is often poor economy of space to put shelves all the way up the wall of a high room, for even with a stepladder considerable effort is required to reach the things at the top. Certainly no articles which are used at all frequently should be kept on high shelves. Practical housekeepers usually keep on open shelves dishes and supplies which are frequently used or from which any dust can be readily removed, and in closed cupboards those which are seldom used or which dust might injure. However, the general tendency nowadays seems to be away from closed cupboards. If doors are used, ample space should be allowed in the room for them to swing out. If space is limited, two narrow doors may be better than one wide one, or the doors may be made to slide instead of swing. Where any kind of a door is impracticable, a curtain on a spring window-shade fixture may be used, but it should be made of material easy to take down and to wash or else should be replaced as often as soiled. Glass doors have the advantage of displaying the contents of the shelves, but the disadvantage of being easily broken. In the cellar or cool pantry frames with wire netting may be used in place of doors as a protection against vermin.

For general use in the kitchen drawers are less convenient than shelves, because more work is required to open and shut and to clean them; they are also more expensive than open shelves. For towels and cloths, however, a few are almost indispensable. Clean old cloths which may be thrown away after use, new cheesecloth for miscellaneous purposes, squares of scrim or flannel for straining, etc., and old newspapers for wiping stove and for other uses will be found a great convenience. A chest of drawers on casters or a small bureau is often more convenient than built-in drawers. For most kitchen purposes shallow drawers are better than deep ones, because the contents require less handling. One of the kitchen cabinets now on the market may be found less expensive to install than its equivalent in closets, shelves, bins, etc., and it will often save much of the labor of preparing meals by grouping in one place the ingredients, appliances, and working space required.

CONCLUSION.

In planning a new home or remodeling an old one it should always be borne in mind that the placing of the stove, sink, and work table in such a way as to secure the advantages discussed in the preceding pages will save the housekeeper many steps in the tasks of the kitchen. Time and energy will also be saved if the shelves, cupboards, and drawers are located near the place where the supplies or equipment which they are to contain are to be used, and they will be even more convenient if they are so planned that their contents may be easily and quickly removed or replaced. In selecting the equipment only that which is most convenient and durable should be purchased. As in any well regulated workshop, all the equipment necessary for the convenience of the worker should be supplied, but that equipment should be installed first of all which will be used most often, and it should be of such a character and so located that it will result in the greatest saving of labor.

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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

608

Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.
August 6, 1914.

REMOVAL OF GARLIC FLAVOR FROM MILK AND CREAM.

By S. Henry Ayers, *Bacteriologist*, and W. T. Johnson, Jr., *Scientific Assistant*, *Dairy Division*.

It is a well-known fact that when cows eat wild onion or garlic within four hours before milking there is imparted to their milk a very disagreeable flavor and odor. This flavor is not only unpleasant but it lowers the commercial value of the milk. Any method, therefore, which will remove this flavor and odor should be of interest to dairymen.

THE EXPERIMENTAL MILK.

In all our experiments milk with a strong onion flavor was used. The milk was prepared by feeding a cow with three-fourths of a pound of wild onion or garlic 20 minutes before milking, and we believe that the milk so obtained has as strong a flavor, probably stronger, than any commercial milk so tainted.

DESCRIPTION OF PROCESS.

Briefly stated, the process which we have used for removing onion or garlic flavor from milk consists in blowing air through milk which is heated to at least 145° F. The apparatus used in our work is shown in figure 1. It consists of a round, open-top tin tank, *A*, of about 4 gallons capacity, surrounded by a water jacket. Supported above tank *A* is a second tank, *B*. Tank *B* has a perforated bottom, the holes being about one thirty-second of an inch in diameter, placed at a distance of about one-half inch apart. This tank stands about 3 inches above tank *A*, and is supported by four legs. There is left, therefore, an open space between the two tanks through which the air escapes after its passage through the milk. An air pipe extends to within one-half inch of the bottom of tank *A*. A pump is also provided with connections to both tanks.

The method for removing onion or garlic flavors is as follows: Milk is placed in tank *A* and heated to 145° F. by means of hot water in the water jacket. During the heating the milk is agitated by mechanical means. It is possible that a slight agitation by air would act as well as a mechanical stirrer, but if such agitation is too violent it may churn the fat in the cold milk. When the temperature has reached 145° F. air under pressure is blown into the milk through the air pipe, which extends nearly to the bottom of tank *A*. This air causes a violent agitation of the milk. When the air is turned on, the milk pump is started and milk is pumped from tank *A* to tank *B*, from which it flows through the perforated bottom and returns to tank *A* in fine streams after the manner of rain. The pumping is continued throughout the blowing process. The principal object of tank *B* is to cause milk to drop into tank *A* in such manner as to destroy the layer of foam which forms on the milk which is being treated with air in the lower tank. This method of allowing the milk to fall in fine streams also aids in aeration and therefore helps in the removal of the onion or garlic flavor.

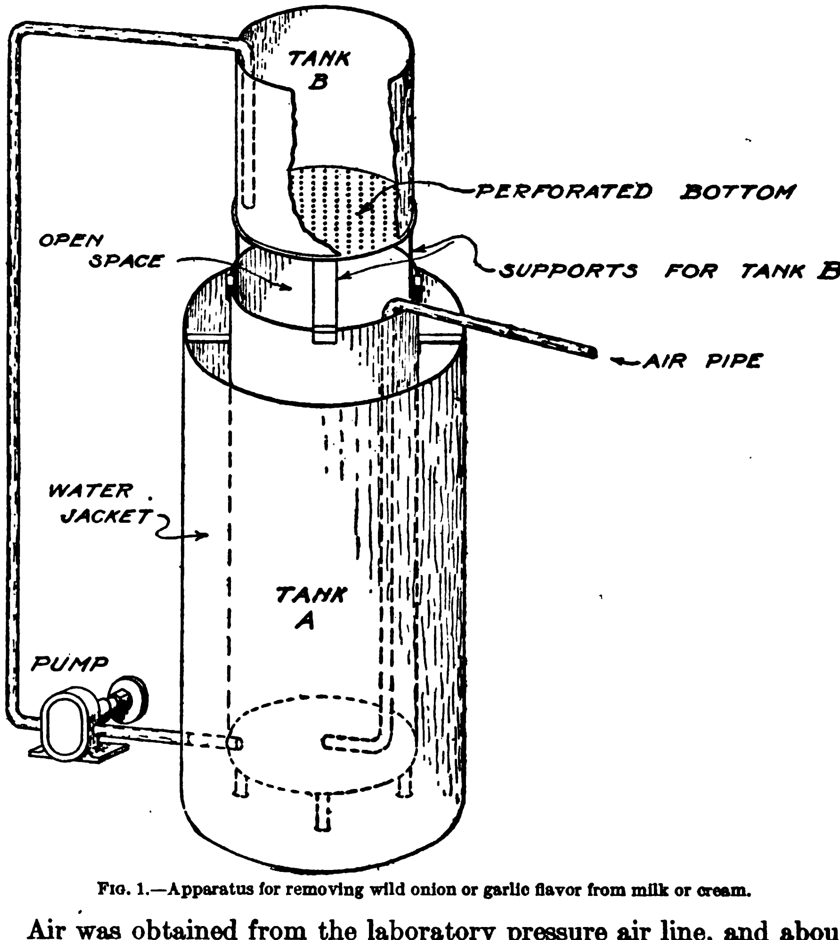

FIG. 1.—Apparatus for removing wild onion or garlic flavor from milk or cream.

Air was obtained from the laboratory pressure air line, and about one-fifth of a cubic foot of air per gallon of milk per minute was used.

PROCESS MOST SATISFACTORY AT 145° F.

In developing this process a large number of experiments were performed, using various temperatures. It was found that some of the onion or garlic flavor could be removed by blowing cold milk, but it was impossible to remove it entirely in any length of time which would be practical for commercial use. In one experiment milk with a strong onion flavor was blown for two hours at a temperature ranging from 50° to 68° F. and the flavor was not removed. The temperature was then raised to 145° F. and after five minutes blowing the onion flavor was entirely removed. It was also found that when cold milk is violently agitated by air the fat churns, and when the milk is subsequently heated, followed by cooling and bottling, as in pasteurization, a thin layer of butterfat forms on the surface of the bottled milk. When milk was blown at temperatures from 70° to 100° F. a layer of melted fat formed in some cases during the blowing process. This was never observed when the temperature of the milk during blowing was 140° F. or above.

RESULTS OF EXPERIMENTS AT VARIOUS TEMPERATURES.

Since the best results were obtained when the milk was treated at temperatures above 140° F., the results of a few experiments on milk and cream which show the length of time required to remove the onion or garlic flavor have been tabulated in Table 1. In experiments Nos. 1 and 2 the milk was blown without the use of the upper tank *B*, while in experiments Nos. 3 and 5, at the same temperature, tank *B* was used. The same volume of air, about one-fifth of a cubic foot per gallon per minute, was used in these experiments. It will be seen, however, that the onion flavor was removed more quickly in experiments 3 and 5 when tank *B* was used. It is probable that the milk falling from tank *B* in fine streams breaks up the layer of foam on the milk in tank *A* and therefore aids in the escape of the onion flavor, which is volatile. The milk also is probably aerated when falling in this manner.

TABLE 1.—*Time required to remove onion or garlic flavor from milk and 30 per cent cream at various temperatures.*

Experiment.	Temperature.	Original onion flavor.	Onion flavor after blowing for period of—			
			10 minutes.	15 minutes.	20 minutes.	30 minutes.
	°F.					
1, milk[1]	145	Strong	Strong			Medium
2, milk[1]	145	do				Faint
3, milk	145	do	Medium		Faint	Very faint
4, milk	160	do	Very faint	Very faint	Absent	
5, milk	145	do		Faint		Absent
6, cream	140	do				Medium
7, cream	150	do		Medium		Very faint
8, cream	145	do				do
9, cream	160	do	Faint		Faint	do

Experiment.	Temperature.	Original onion flavor.	Onion flavor after blowing for period of—				
			40 minutes.	45 minutes.	50 minutes.	60 minutes.	75 minutes.
	°F.						
1, milk[1]	145	Strong	Very faint				
2, milk[1]	145	do	Faint		Faint	Absent	
3, milk	145	do	Absent				
4, milk	160	do					
5, milk	145	do					
6, cream	140	do		Medium		Very faint.	Absent.
7, cream	150	do		Absent			
8, cream	145	do		do			
9, cream	160	do	Absent				

[1] Upper tank with perforated bottom not used.

Experiment No. 4 shows that the onion flavor in milk is removed more quickly when the milk is heated to 160° F. There is produced, however, at this temperature a cooked taste and the cream line is reduced to a greater extent than when the milk is heated and blown at 145° F. When milk was blown at 145° F. the experiments showed that there was about a 50 per cent reduction in the cream line. The effect on the cream line will vary with the amount of agitation of the milk and the length of the blowing period.

It is seen from the table that the onion or garlic flavor was removed entirely from milk at the temperatures given in from 30 to 60 minutes. It is evident, of course, that the length of the blowing period will depend upon the strength of the flavor in the milk. In one experiment not shown in Table 1 the flavor was removed by five minutes blowing. In this case, however, the onion or garlic flavor was not strong in the milk before treatment.

REMOVING THE FLAVOR FROM CREAM.

In order to remove the flavor from cream it was found that in general a slightly longer blowing period was required than in the case of milk. The results of four experiments with 30 per cent cream are shown in Table 1. Here again the results show that the onion or garlic flavor may be removed more quickly at 160° F. than at 140° or 145° F. It would probably be possible to use 160° F. when the cream is to be used for butter making, but for direct consumption the cooked taste produced by long heating at 160° F. is undesirable.

EVAPORATION.

When milk or cream is treated by this process it was found that there is a loss by evaporation which amounts to 2 or 3 per cent. Therefore it is advisable to use the minimum amount of air which will remove the onion or garlic flavor.

COMMERCIAL USE OF THE PROCESS.

The application of this process on a commercial scale would be simple, as an ordinary tank could be used with another tank with a perforated bottom supported above it. The size of the air blower necessary to supply air will depend upon the amount of milk to be blown and the depth of the milk, since air has to be forced to the bottom of the tank. It is desirable that the air be filtered and washed before its passage into the milk, in order to remove dust.

Any of the manufacturers of air blowers will determine the size necessary when supplied with the proper data; that is to say, the amount of air pressure which the blower must provide.

The experiments indicate that onion or garlic flavor may be removed on a commercial scale from milk and cream by the simple process which has been described. It is believed that the milk or cream for direct consumption should be heated and blown at 145° F. in order to obtain the best results, but the temperature used and the method of application of the process will depend upon the particular needs of the creamery operator.

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FARMERS' BULLETIN

609

Contribution from the Bureau of Biological Survey, Henry W. Henshaw, Chief.
September 11, 1914.

BIRD HOUSES AND HOW TO BUILD THEM.

By Ned Dearborn,
Assistant Biologist.

INTRODUCTION.

Birds may be gathered about us in all seasons of the year with ease and certainty merely by offering what they desire. In winter they are often pushed for food, and if we supply this need they will report daily at the lunch counter and help to relieve the tedium of our indoor life. In summer they care less for food provided by their human friends, and other means must be sought to attract them about the home. They appreciate fresh water for bathing and drinking. A shallow pool of varying depth, if only a foot across, becomes on hot days a center of attraction for all the birds in the vicinity, and it may be made with little effort and material; only a small amount of cement is required, or, if that be lacking, a pan with stones in it set in the ground will be equally serviceable. Trees, shrubs, and vines bearing fruit relished by birds are great attractions in their season.[1]

Birds are desirable about premises not only on account of their beauty and song, but because of their economic worth. They are especially useful as insect destroyers during the breeding period, when they have to work early and late to obtain sufficient food for their nestlings, and their movements at this time are more interesting than during any other season. There is, therefore, a double purpose in offering them special nesting facilities. If mud is available, swallows, robins, and phœbes will found and wall their nests with it. If we put out feathers, bits of wool, or twine, a dozen different kinds of birds will make use of them. If we furnish safe retreats in which they can rear their young comfortably, most of them will be occupied. In fact no attraction for summer birds is more effectual

[1] See U. S. Dept. Agr. Yearbook 1909, pp. 185–196, "Plants Useful to Attract Birds and Protect Fruit," by W. L. McAtee (Yearbook Separate 504.)

Note.—This bulletin is intended to encourage the protection and study of birds; it is suitable for distribution in all sections of the United States.

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than a series of houses suited to the needs and habits of the various kinds of house birds.

A few years ago only four species were commonly regarded as house birds—the house wren, the bluebird, the tree swallow, and the martin. Since the movement to protect birds and make neighbors of them began, however, their natures and needs have become better understood, and it is now known that many other species will avail themselves of houses constructed for them by their human friends. The practice of erecting bird houses in this country, while now nation-wide, is not so common and uniformly distributed as it should be, and more extended provisions of this nature can not fail to result in a largely increased number of house birds.

HOUSE BIRDS INCREASING IN NUMBER.

The habit of nesting in bird houses has been adopted by individuals of many species which would not ordinarily be expected to make use of such homes, and this may be taken as indicating that it will become more general from year to year as facilities are afforded and as the number of birds hatched in houses increases.

That western wrens and bluebirds should take as naturally to artificial shelters as did their eastern relatives was to be expected. On the other hand, the use of houses by birds which until recently had persistently ignored them is surprising and must be considered a victory for those who have studiously attempted to enlarge their circle of feathered neighbors.

Woodpeckers, nuthatches, and titmice excavate their own houses, usually new ones each year, leaving the old homes to less capable architects. Builders of artificial houses generally go to the woodpecker for designs, and by varying styles to suit the tastes of different kinds of birds, have been rewarded by such tenants as chickadees, tufted titmice, white-breasted nuthatches, Bewick and Carolina wrens, violet-green swallows, crested flycatchers, screech owls, sparrow hawks, and even some of the woodpeckers, the master builders themselves. Flickers readily accept houses built according to their standards. Red-headed and golden-fronted woodpeckers are willing occupants of artificial houses, and even the downy woodpecker, that sturdy little carpenter, has, in one instance at least,[1] deemed such a home a satisfactory abode in which to raise a family. Shelters having one or more sides open are used by birds which would never venture into dark houses suited to woodpeckers. They have been occupied by robins and brown thrashers, and, in one instance, by a song sparrow.[2]

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[1] Reported by Jefferson Butler as occurring on the Ford farm, near Detroit, where great pains have been taken to provide for birds.

[2] This song sparrow record is another surprise from the Ford farm, announced by Mr. Butler, which is very encouraging to those experimenting with bird houses.

The number of house birds may be still further augmented as time goes on. All of the commoner woodpeckers are likely to be included, as are several of the small owls and wrens, and a few of the wild ducks, as the golden-eye. The wood duck is already known to use nesting boxes. Houses set close to streams in the western mountains will probably be occupied by ousels or dippers. Florida grackles sometimes breed in flicker holes and may be expected to occupy houses now and then. In every locality having trees there is a group of birds ready to appropriate houses when they have the opportunity.

SUGGESTIONS FOR CONSTRUCTING HOUSES.

House birds differ decidedly in their requirements. For those which usually excavate homes for themselves, the diameter of the entrance and the depth and diameter of the cavity must be in accord with their specific standards. Some birds are satisfied with almost any sort of a lodging. Bluebirds and wrens, for example, are content to build in tomato cans, although chickadees and nuthatches disdain them. Wood is a better building material than metal or earthenware. Entrance holes should be countersunk from the outside to exclude rain. Heads of nails and screws should be set rather deeply and covered with putty. All houses should be easy to open for cleaning. A perch at the entrance is unnecessary and may even be an objection, as it is frequently used by English sparrows while they twitter exasperatingly to more desirable occupants. To provide for proper ventilation a row of small holes is sometimes bored just beneath the eaves, but there should never be a ventilating hole lower than the entrance, and joints should be made tight, as drafts of air are dangerous. In case there is danger that rain may be driven in through the door, a small drainage hole, which will be covered by the nest, may be made in the middle of the floor.

The appearance and durability of houses are improved by a coat of paint. A neutral shade of green or gray is suitable for houses mounted in trees, while those on poles, being conspicuously placed, lend themselves harmoniously to the landscape when painted white.

The dimensions of nesting boxes shown in Table 1 are taken from the experience of successful builders and from measurements of woodpecker holes.

TABLE 1.—*Dimensions of nesting boxes for various species of birds.*

Species.	Floor of cavity.	Depth of cavity.	Entrance above floor.	Diameter of entrance.	Height above ground.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Feet.*
Bluebird	5 by 5	8	6	1½	5 to 10
Robin	6 by 8	8	(1)	(1)	6 to 15
Chickadee	4 by 4	8 to 10	8	1⅛	6 to 15
Tufted titmouse	4 by 4	8 to 10	8	1¼	6 to 15
White-breasted nuthatch	4 by 4	8 to 10	8	1¼	12 to 20
House wren	4 by 4	6 to 8	1 to 6	⅞	6 to 10
Bewick wren	4 by 4	6 to 8	1 to 6	1	6 to 10
Carolina wren	4 by 4	6 to 8	1 to 6	1⅛	6 to 10
Dipper	6 by 6	6	1	3	1 to 3
Violet-green swallow	5 by 5	6	1 to 6	1½	10 to 15
Tree swallow	5 by 5	6	1 to 6	1½	10 to 15
Barn swallow	6 by 6	6	(1)	(1)	8 to 12
Martin	6 by 6	6	1	2½	15 to 20
Song sparrow	6 by 6	6	(2)	(2)	1 to 3
House finch	6 by 6	6	4	2	8 to 12
Phœbe	6 by 6	6	(1)	(1)	8 to 12
Crested flycatcher	6 by 6	8 to 10	8	2	8 to 20
Flicker	7 by 7	16 to 18	16	2½	6 to 20
Red-headed woodpecker	6 by 6	12 to 15	12	2	12 to 20
Golden-fronted woodpecker	6 by 6	12 to 15	12	2	12 to 20
Hairy woodpecker	6 by 6	12 to 15	12	1½	12 to 20
Downy woodpecker	4 by 4	8 to 10	8	1¼	6 to 20
Screech owl	8 by 8	12 to 15	12	3	10 to 30
Sparrow hawk	8 by 8	12 to 15	12	3	10 to 30
Saw-whet owl	6 by 6	10 to 12	10	2½	12 to 20
Barn owl	10 by 18	15 to 18	4	6	12 to 18
Wood duck	10 by 18	10 to 15	3	6	4 to 20

[1] One or more sides open. [2] All sides open.

HOUSE PLANS.

Possibilities in the way of improvising bird houses with very little work are suggested in figures 1 and 2. Ordinary tomato cans treated in either of the ways here indicated will be tenanted by wrens and bluebirds. The cans ought always to be placed in shaded places, as the metal becomes very hot in the sun.

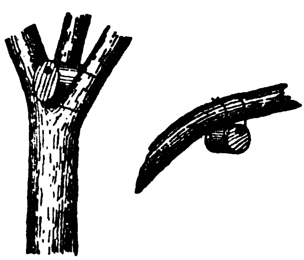


FIG. 1.—Tomato can with circular piece of board fitted in one end, to make house for bluebirds or wrens.

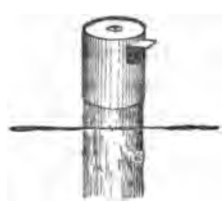


FIG. 2.—Tomato can, with one end removed, fastened to top of post. Hole cut in side for entrance. Suitable for bluebirds or wrens if put in shady place.

Bird houses in the Southern States have long been made from gourds. The entrance is in the side and a drain hole in the bottom, as shown in figure 3. A piece of wire through the neck for mounting it completes the house. A number of gourds thus prepared and strung on a pole seems to make a satisfactory tenement house for a colony of martins. Used singly they are equally well adapted to wrens and bluebirds. While gourds are not durable when exposed to the weather they are easily replaced.

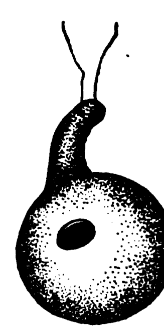


FIG. 3.—Gourd for martins.

Ordinary wooden boxes, if clean, can be made into bird houses by merely nailing on a cover and cutting out an entrance hole. Such makeshifts are rarely weatherproof and are never pleasing to the eye. Branches containing real woodpecker holes, when obtainable, are perhaps the best attraction that can be offered most house birds in the breeding season. By carefully fitting such a branch to a fruit or shade

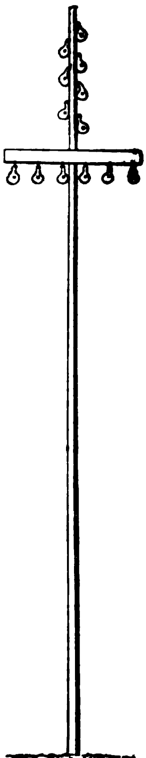


FIG. 4.—Gourds arranged for martins.

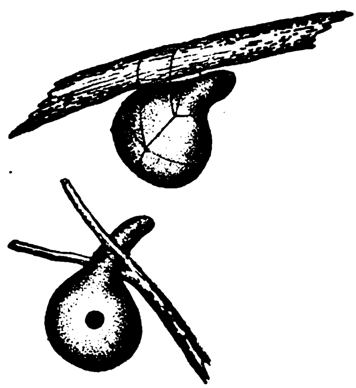


FIG. 5.—Gourds for wrens or bluebirds.

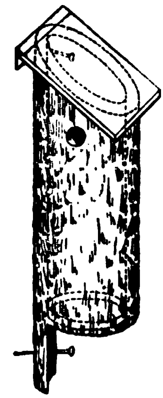
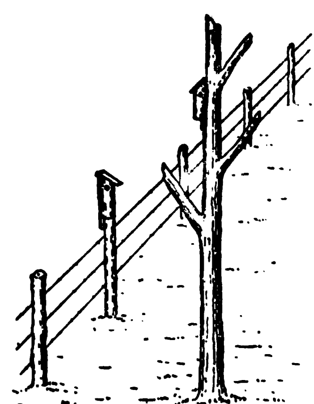


FIG. 6.—House made from hollow log.

tree its foreign origin will scarcely be noticed. The house shown in figure 6 is suitable for use in trees. It is made from a log or large branch, hollowed by decay, and fitted with a top and bottom as illustrated in the figure. The cover is to go on after the log is fastened in place. Either the top or bottom should be removable. Methods of doing this are shown in figures 23 and 26. Another way of making a log house is to split a straight-grained log 2 feet or more in length through the middle and then to cut out a cavity with a gouge. The excavations in the two halves can be made to match exactly by means of a pattern or template having the size and shape desired for the proposed cavity through the plane of cleavage. Figure 7 shows the appearance of such a house and how to place the template symmetrically on each half of the stick. The top of this house should be covered with tin or zinc to keep out moisture. The halves should be fastened together with screws to allow the house to be taken apart and cleaned.



Phœbes like to nest about buildings, and a simple shelf under the roof of a porch or shed is all they require. If, however, it is desirable to have them stay outside, the shelf must be provided with a roof. Figure 8 shows a shelf shielded from the weather by one wall and a roof. This shelf if placed high under the eaves of a two-story building may attract barn swallows; phœbes and robins also are likely to build upon it if it is not less than 8 feet from the ground. In some cases it will be advisable to leave only one side open.

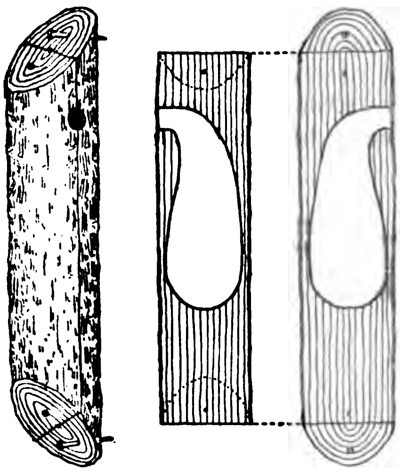


FIG. 7.—Log split and halves marked to be gouged out to form a cavity. Halves to be screwed together. Top should be covered with tin or zinc.

A nest shelter designed to be placed in shrubbery for catbirds, brown thrashers and song sparrows is shown in figure 10. As it requires little lumber or labor, one may well be placed in every patch of weeds or brush frequented by these birds. Fastened to a large horizontal branch or in a crotch of a tree it is likely to be used by robins.

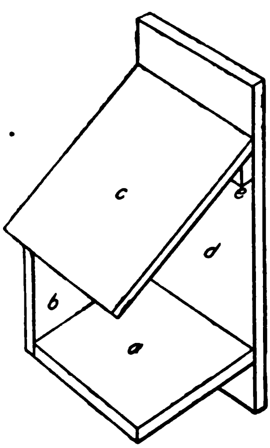
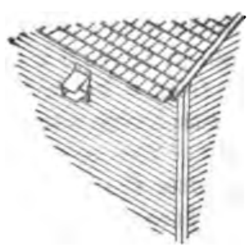


FIG. 8.—Outdoor nest shelf.



The house shown in figures 12 to 15 is designed to be set on a pole or a tree stub for the use of swallows especially. It can be cleaned by simply lifting the box from its base. Bluebirds and wrens, as well as swallows, nest in this style of house though they prefer a deeper cavity. Another pole house is shown in figure 17. This is essentially after the woodpecker model and is suitable for bluebirds. By releasing the hooks which fasten the box to the base, cleaning is easy. Figure 19 illustrates a house to be attached to a tree. It can be

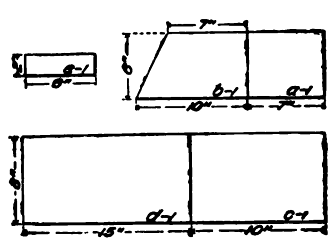


FIG. 9.—Diagrams for outdoor nest shelf shown in figure 8.

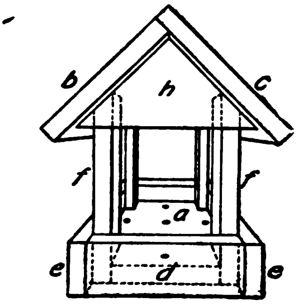


Fig. 10.—Nest shelter.

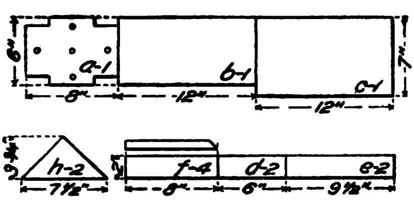
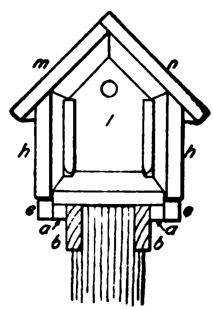


Fig. 11.—Lumber diagrams for nest shelter shown in figure 10. Thickness of boards ¾ inch.



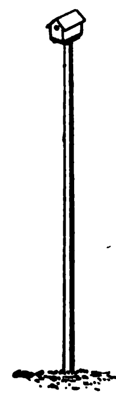


Fig. 12.—Cross section and interior view of front half of house for swallows and bluebirds.

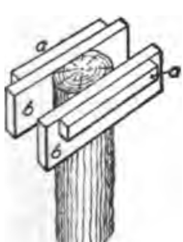


Fig. 13.—Foundation for house shown in figure 12.

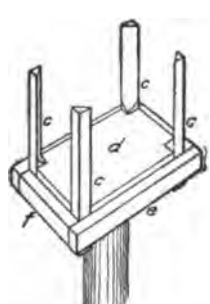


Fig. 14.—Floor and posts added to foundation shown in figure 13.

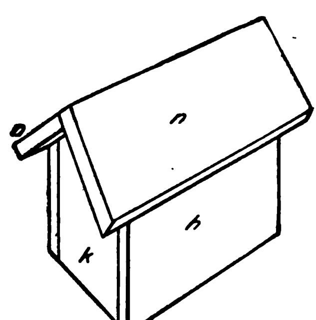


Fig. 15.—House ready to place over floor and posts as shown in figure 14.

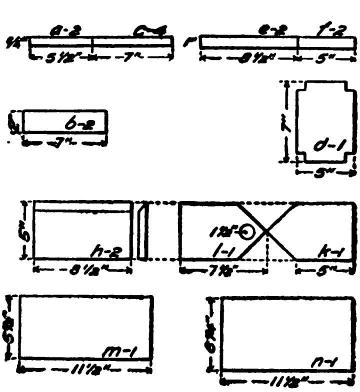


FIG. 16.—Lumber diagrams for building house shown in figures 12 to 15. Thickness of boards ¾ inch.

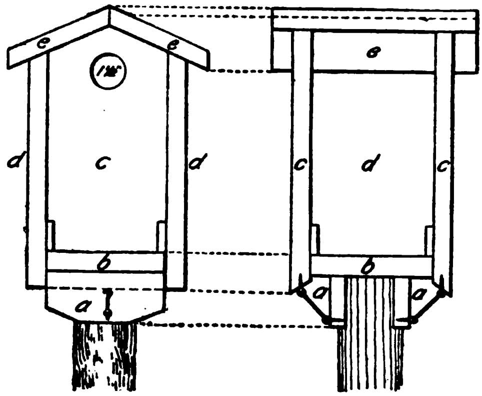


FIG. 17.—Diagrammatic drawings of bluebird house. This house can be removed from its floor by unfastening two wire hooks.

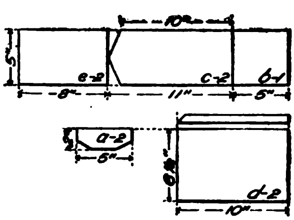
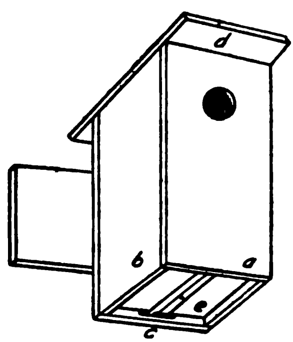


FIG. 18.—Lumber diagrams of house shown in figure 17. Thickness of boards ¾ inch.



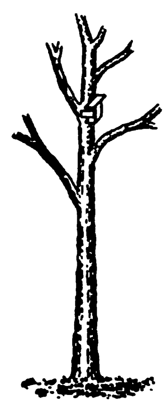


FIG. 19.—Style of house suitable for sparrow hawks, screech owls, bluebirds, and wrens. Designed to be placed in trees. Bottom can be removed by turning button.

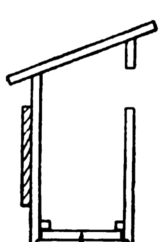


FIG. 20.—Section of house shown in figure 19.

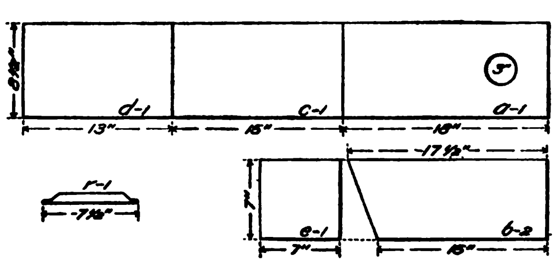


FIG. 21.—Diagrams of house shown in figure 19 for sparrow hawks and screech owls. Thickness of boards ¾ inch.

opened for cleaning by turning a button and removing the bottom. This house is easy to build and if suitably proportioned is adapted to a great variety of birds. Plans are furnished for two sizes—one for bluebirds and the other for screech owls or sparrow hawks.

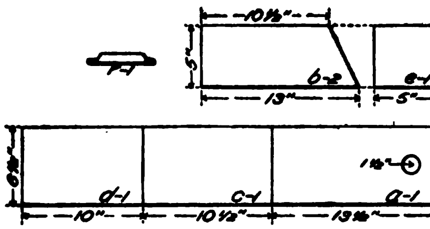


FIG. 22.—Diagrams of house shown in figure 19 for bluebirds. Thickness of boards ¾ inch.

The flicker house shown in figure 23 is designed to be placed on a post or the stub of a tree. The roof can be lifted in the same way that a stopper is removed from a bottle. A house suitable for members of the woodpecker family and also for nuthatches and titmice, including chickadees, is shown in figure 25. It is attached to boles of trees. The bottom is removable, as appears in figure 26.

Figure 29 shows a house designed for wrens and house finches. For wrens it may be placed on a tree or fence post. If attached near the eaves of a building, house finches or wrens will use it. The front gable is open, entrance to the room below being through the rear of the upper floor. This house can be opened for cleaning by lifting out the upper floor.

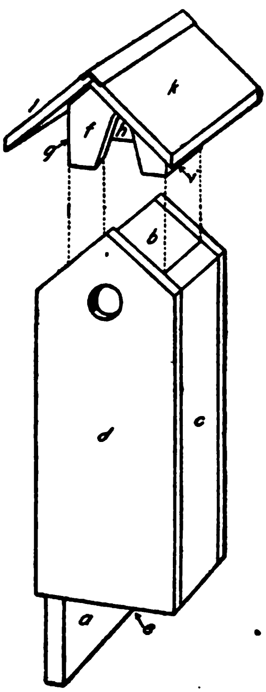
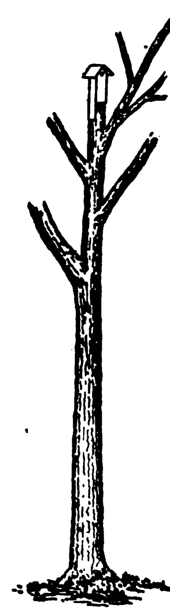


FIG. 23.—Flicker house to be mounted on post or stub of tree.

Martin houses are built on the apartment plan to satisfy the social instinct so marked in martins but so conspicuously lacking in most other birds. They usually contain not less than 10 or 12 rooms and for this reason are relatively complicated, especially if they are miniatures of elaborate buildings, as is often the case. Like the single room houses, they should be easy to inspect and clean from top to bottom and, if possible, should be made proof against the English sparrow. An attempt to combine these essentials in a plain house is illustrated in figure 32. The body of this house slides upon its pole, to the top of which the roof is solidly attached (fig. 36). The pole is hollow and



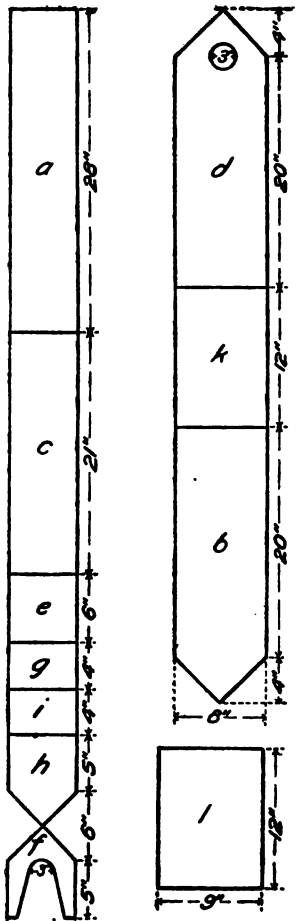


FIG. 24.—Lumber diagrams for flicker house shown in figure 23. Thickness of boards ¾ inch.

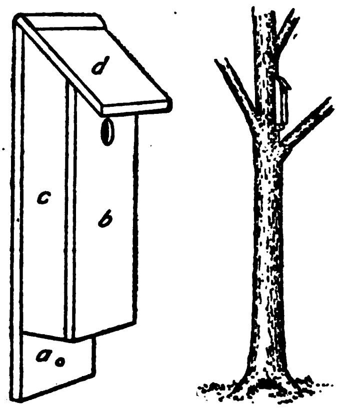


FIG. 25.—House to be placed in tree for woodpeckers, chickadees, nuthatches, or titmice.

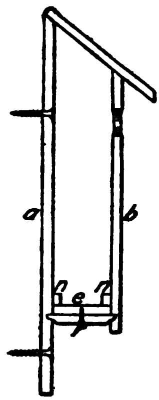


FIG. 26.—Section of house shown in figure 25.

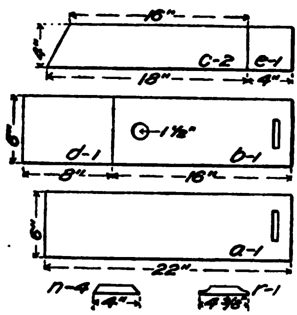


FIG. 27.—Lumber diagrams of house shown in figure 25, suitable for downy woodpecker. By reducing size of entrance it becomes right for titmice and nuthatches. Thickness of boards ¾ inch.

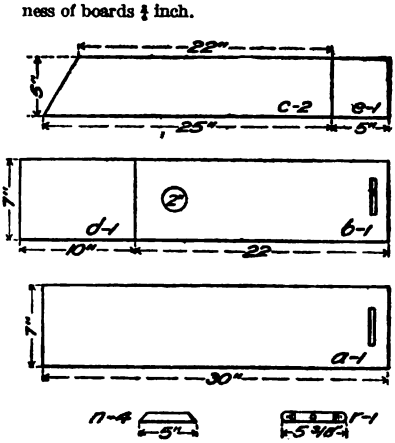


FIG. 28.—Lumber diagrams of house shown in figure 25, suitable for red-headed woodpecker. Thickness of boards ¾ inch.

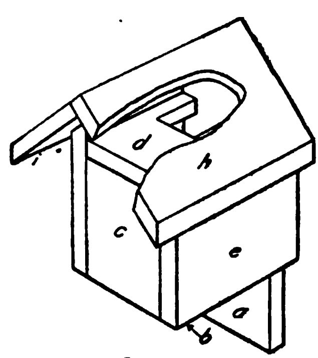


FIG. 29.—House for wrens and house finches. Roof broken to show interior.

through it runs a cord by which the house is raised and lowered. The floors are all removable by lifting up. When the house is out of contact with the roof all of the entrances are closed by gates actuated by springs, the gates moving upward to close, and being kept down and open by pressure against the roof. By means of this device sparrows may be kept out of the house until martins are due to arrive, or if they get in when the house is open they can be trapped by suddenly lowering it. The pole shown here is made from hardwood boards put together with screws. The concrete base has a core of 2-inch iron pipe which extends upward far enough to make a firm connection with the upper part on which the house slides. A heavy weight is employed to hold the house hard against the roof. By passing the cord around the hook of the weight exactly as shown in figure 39 and pulling it upward until the weight is clear of the ground, it can easily be held without slipping while a more secure knot can be tied. A hook less wearing to the cord and fully as serviceable may be made from an acute natural crotch of oak or other

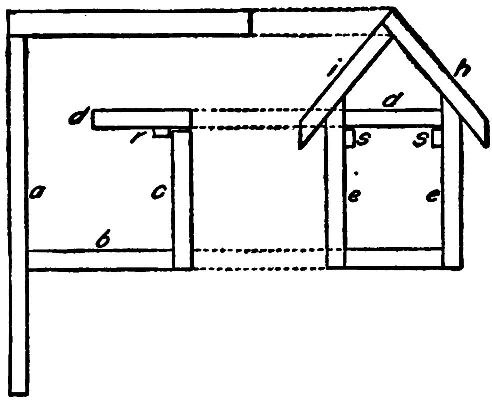


FIG. 30.—Sections of house shown in figure 29. Upper floor removable.

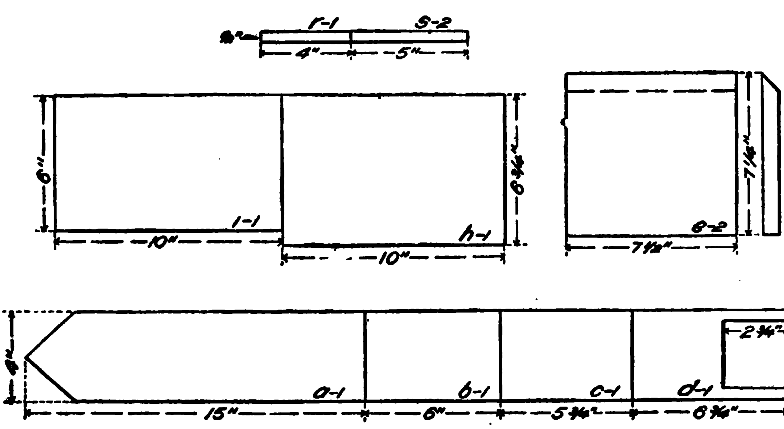


FIG. 31.—Lumber diagrams for house shown in figure 29. Thickness of boards ¾ inch.

hardwood instead of iron. Where this house is exposed to strong winds it may be advisable to attach guy wires to corners of the roof. The pole may be made of a single piece of 4-inch galvanized pipe, set in a concrete base. In this case the house should be a cylinder and the roof a cone.

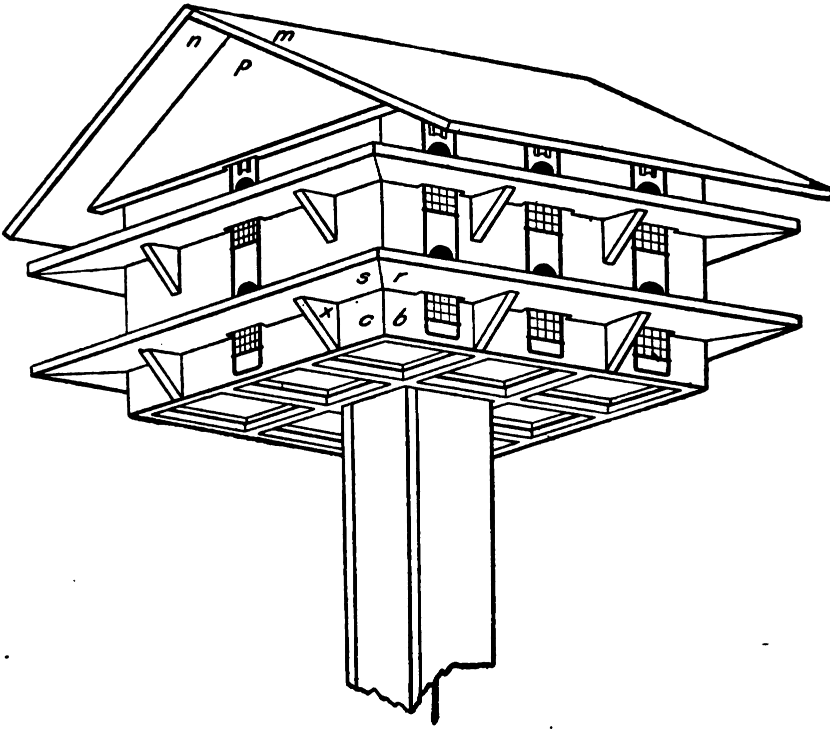


FIG. 32.—Martin house.

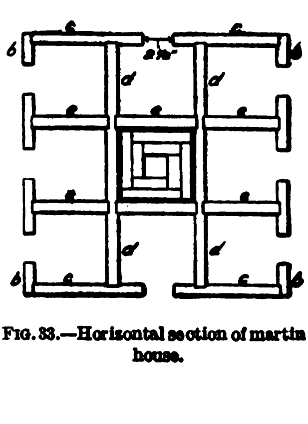


FIG. 33.—Horizontal section of martin house.

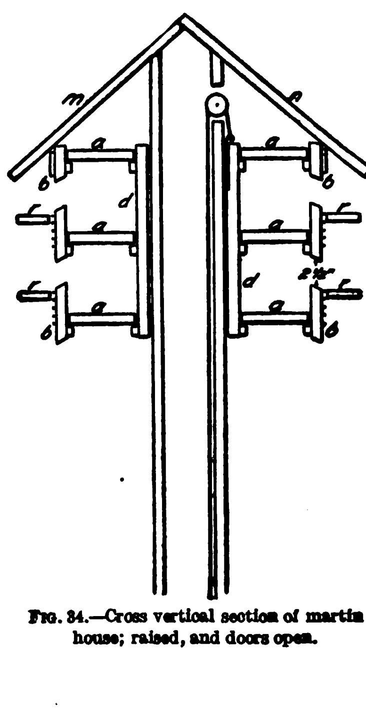


FIG. 34.—Cross vertical section of martin house; raised, and doors open.

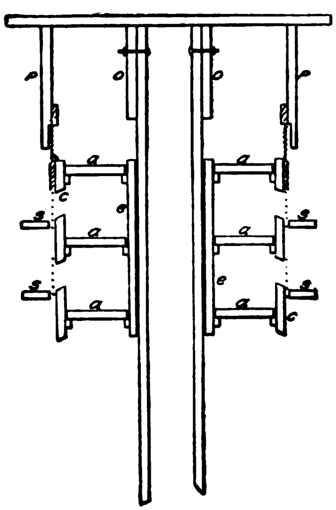


FIG. 35.—Longitudinal vertical section of martin house; lowered, and doors closed.

FIG. 36.—Roof of martin house attached solidly to pole.

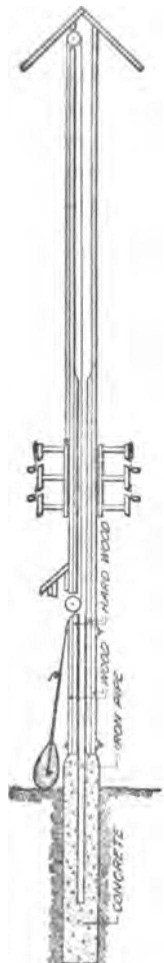


FIG. 37.—Martin house lowered; doors closed.

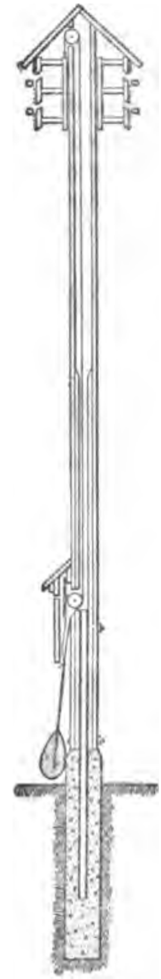


FIG. 38.—Martin house in place; doors open.

FIG. 39.—Proper way to make first "hitch" of rope on hook of counterweight.

CARE OF HOUSES.

Each spring before birds return from the South all filth and litter should be carefully removed from bird houses. In addition to the relics of previous occupancy, houses are likely to contain cocoons of insects, and nests of bees or squirrels. Attention to this one item of spring cleaning is a substantial factor in attaching birds permanently to their houses. A little sulphur scattered about a house is a good

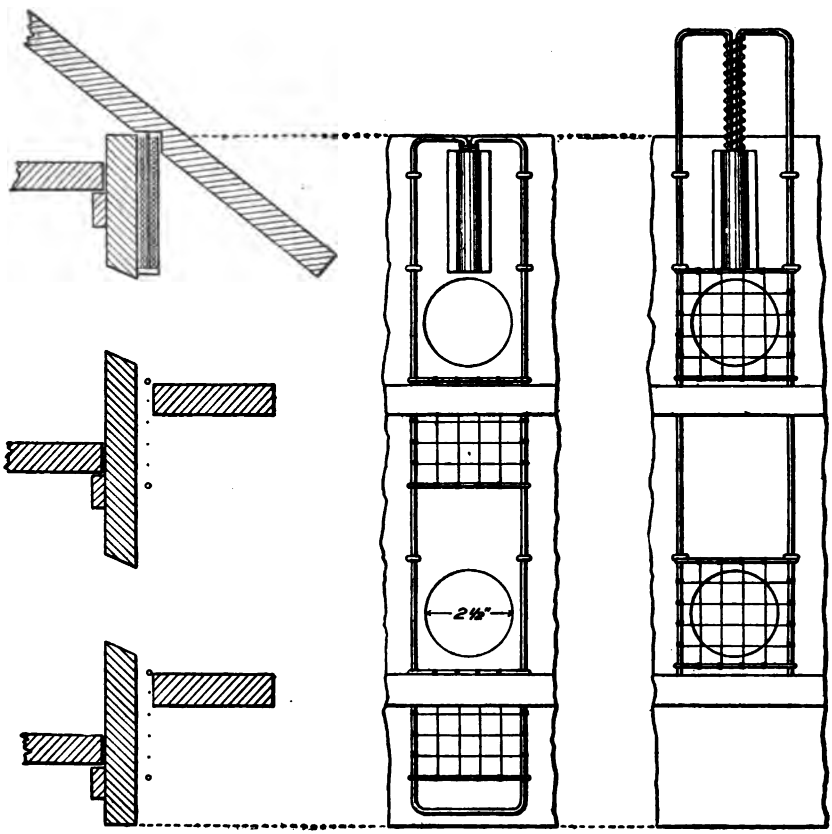


FIG. 40.—Details of construction and operation of gates.

remedy for parasites. When bluebirds or swallows take possession of a martin house it is a good plan to put up a one-room house in the vicinity and remove the nest from the martin house. Interlopers, thus evicted, often transfer their housekeeping to the small house. Houses designed for woodpeckers should always have an inch or so of sawdust in the bottom for the reception of eggs, as woodpeckers do not gather nest materials. Due attention should be given to repairs. It is easier to keep houses in good order than to build new ones.

ENEMIES OF HOUSE BIRDS.

Birds have numerous enemies from which a careful landlord will try to guard them. Among these is the English sparrow, whose persistent attacks too often drive more desirable birds away from their nests and from the neighborhood. Those who wish to free their premises of these sparrows will find recommendations in Farmers' Bulletin 493, The English Sparrow as a Pest. European starlings, which at present are not distributed beyond a narrow strip of the Atlantic coast

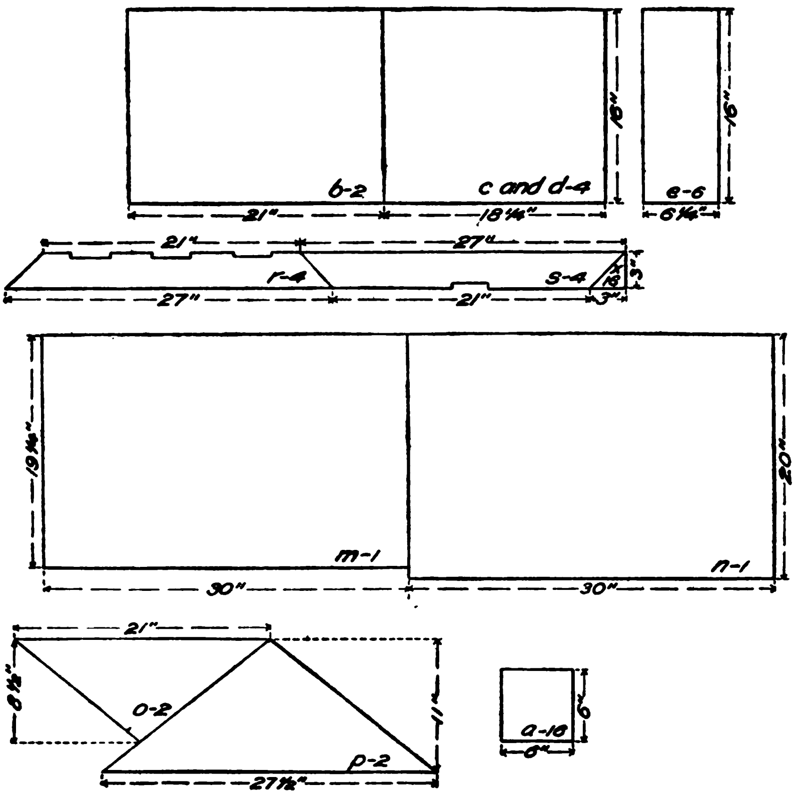
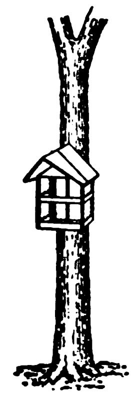


FIG. 41.—Lumber diagrams for martin house. Thickness of boards ¾ inch.

region centering about New York, are to be condemned for their pernicious interference with native house birds.

Cats and large snakes are enemies of birds, the former perhaps killing more birds than any other mammal. Trees and poles supporting houses should be sheathed with tin or galvanized iron to prevent these enemies from climbing to the nests. Squirrels give more or less trouble by gnawing houses, eating eggs, and killing nestlings. Red squirrels, in particular, have a very bad reputation in this respect, and many experimenters keep their grounds free from them. Some regard flying squirrels as but little better than red ones. Even gray and fox squirrels are occasionally troublesome. It is not necessary, however, that bird lovers should wage indiscriminate warfare against all squirrels. It is far better to adopt the rule never to kill a squirrel unless there is reason to believe that it has acquired the habit of eating eggs or young birds; the result will probably be that not more than one red squirrel in fifty nor more than one gray squirrel in a hundred will have to be killed. Where squirrels are numerous they give more or less trouble by gnawing and disfiguring houses. This damage may be prevented, however, by covering the parts about the entrance with tin or zinc.

FIG. 42.—Food shelter for attachment to trunk of tree.



FOOD SHELTERS.

Another means of attracting birds about human habitations is to furnish an abundance of food, preferably in food shelters. If one is unable to make shelters that will protect food in all kinds of weather, the food may be fastened to trunks or branches of trees or scattered in sheltered places on the ground. A decided advantage in having shelters, aside from that of protecting food, is that they may be placed where the birds can be watched conveniently. When shelters are used the birds are first baited by placing food, such as suet, seeds, or cracked nuts, in a conspicuous place, and then led by degrees to enter the inclosure. Designs for two food shelters are exhibited in figures 42 and 46, one of which is supported by a post, the other by a tree. Structural details are shown for both. There is no bottom to either of them.

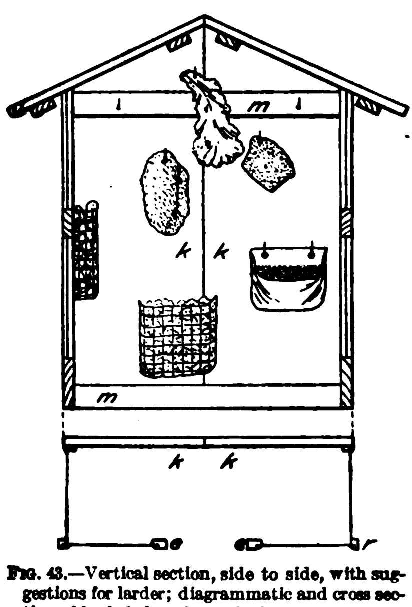


FIG. 43.—Vertical section, side to side, with suggestions for larder; diagrammatic and cross section of food shelter shown in figure 42.

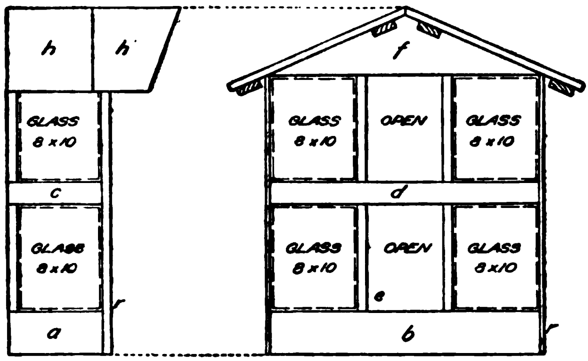


FIG. 44.—Front and side elevations of shelter shown in figure 42.

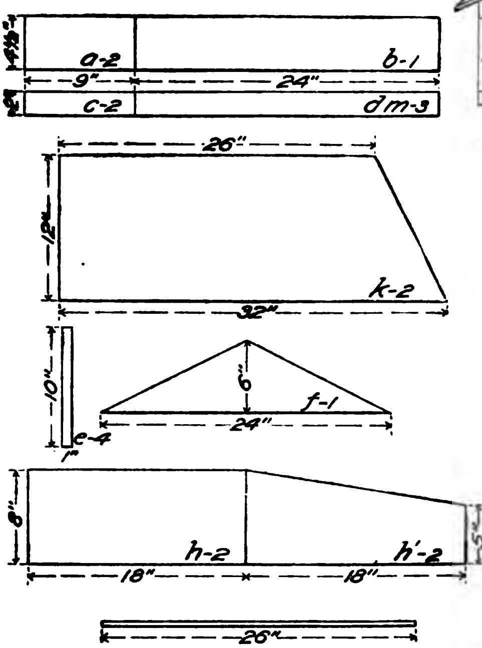


FIG. 45.—Lumber diagram of food shelter shown in figure 42.

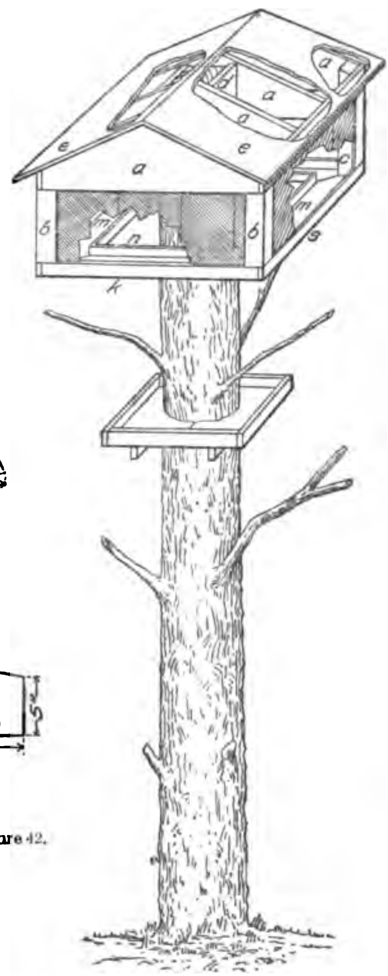


FIG. 46.—Food shelter for attachment to post. Roof cut away to show construction. Sides made of glass; size of panes 8 by 10 inches.

LOCATION.

The location of a bird house or food shelter has much to do with its success, for the reason that birds have decided notions as to proper surroundings for a dwelling. Martins prefer to breed near houses, but not within 20 feet of trees or buildings. Bluebirds are inclined to select orchards or pastures having scattered trees. Wrens, thrashers, and catbirds live in thick shrubbery. Robins like trees with sturdy trunks and branches. Titmice, nuthatches, and most of the woodpeckers are woodland species, although flickers and red-headed woodpeckers are more at home among the scattered trees of roadsides and pastures. Song sparrows frequent weedy swales and brush fences. Swallows do not enter woods so that a house would be as attractive to them in one open place as in another. The eastern phœbe, the black phœbe, and the house finch, while not limited to the haunts of man, are noticeably partial to them. Crested flycatchers, screech owls, barn owls, and sparrow hawks are governed more by convenience than by taste; although normally inclined to hold aloof from

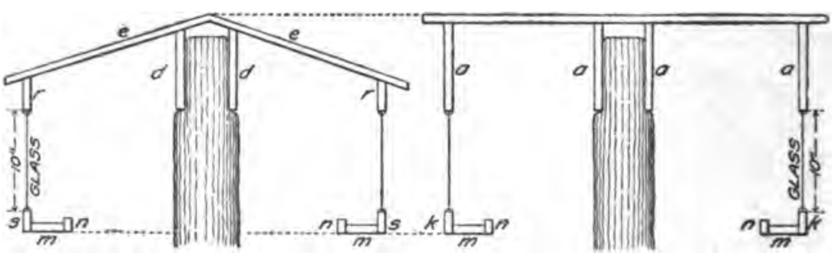


FIG. 47.—Cross and longitudinal sections of food house shown in figure 46.

man, they have in many instances reared their broods in close proximity to dwellings. Barn owls, true to their name, accept suitable quarters in buildings without hesitation.

CONCLUSION.

Before erecting bird houses one should first determine the kind of birds to which his premises are adapted. The question usually next arising is as to the number of birds that can be accommodated. Unless grounds are large, it is generally useless to expect as tenants more than a pair of each species, except martins. However, the singular intolerance shown by most birds during the breeding season to others of their kind does not operate between those of different species. A dozen different kinds of birds will pursue their several modes of hunting and raise their families on the same lot, but rarely two of the same sort.[1] Of all our house birds, martins alone are

[1] The fact that birds are more tolerant toward strangers than toward relatives was well illustrated by an observation made recently by the writer in New Mexico. A one-story tool house 10 feet square had nailed to three corners of its roof rough bird houses made from packing boxes. One was occupied by violet-green swallows, another by western bluebirds, and the third by English sparrows. A still more remarkable association of different species has been reported by Otto Widmann, of St. Louis, Mo., who once had a pair each of flickers, martins, house wrens, and English sparrows nesting simultaneously in the same house.

social. The fact that there is a limit to the possible bird population on any given tract must be taken into consideration. When the probable tenants have been decided upon, the selection of sites is in order, for the site often decides the style of house that is to occupy it. In the final placing of bird houses, care should be taken to have them

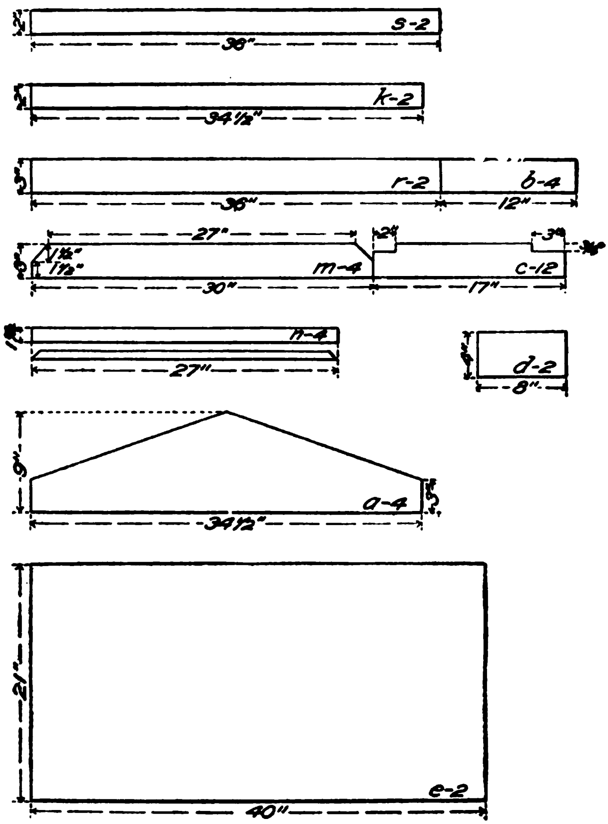


FIG. 48.—Lumber diagrams of food shelter shown in figure 46.

face away from the winds prevailing in stormy weather. The strongly developed homing instincts of birds can be relied on to attach them to the neighborhood where they first saw the light, and the identical pairs which nest in the houses provided for them one year will often return the next season to enjoy the same bounty and protection.

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U.S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN
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Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.
September 9, 1914.

WILD ONION: METHODS OF ERADICATION.

By H. R. Cox, *Agriculturist, Office of Farm Management.*

INTRODUCTION.

The wild onion, or garlic (*Allium vineale*), is found in the Atlantic coast region from Massachusetts to Georgia and as far inland as Missouri (fig. 1), and in a large part of that territory it is the worst weed pest. In the spring the cows eat the plant, which results in the dairy products becoming tainted with the offensive odor and flavor. The farmer harvests with his wheat the onion bulblets, which are about the same size and shape as the wheat grains, and the two are difficult to separate. Therefore, when the wheat is offered for sale the millman docks him a liberal amount. Bread made from garlicky flour, especially if eaten warm, has a pronounced odor and flavor. The money loss from wild onion runs into millions of dollars yearly, while the gastronomic discomfort to the consumers of the tainted flour and dairy products is no minor consideration. During the winter and early spring the green tops of this weed detract much from the appearance of lawns.

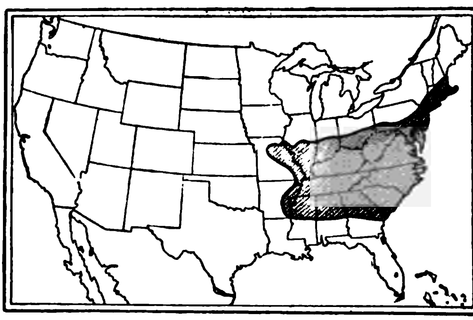

Fig. 1.—Sketch map of the United States, showing the distribution of the wild onion.

DESCRIPTION AND HABITS OF GROWTH.

It is highly important to understand how this plant grows, because on a knowledge of its life habits is based the best method for its

Note.—This bulletin describes methods for eradicating the weed that is responsible for the "garlicky" taste and odor found in some milk and butter and in some bread and is of especial interest to farmers and dairymen in the Atlantic coast region and as far inland as Missouri. The subject matter is based on and is an enlargement of the Bureau of Plant Industry circular (Doc. No. 416) entitled "The Wild Onion," by J. S. Cates and H. R. Cox.

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eradication. In cultivated lands the plants are likely to be scattered, but in pastures, lawns, and other places that have not been disturbed for several years the plants grow in clumps.

The wild onion ripens in June or July, at which time the aboveground portion consists of a stem with several narrow leaves growing along the lower part. This stem is 1½ to 3½ feet tall, and on the top is found a cluster or several clusters of the aerial bulblets shown in figure 2, sometimes incorrectly called seeds. The plant seldom produces true seeds. The underground portion, which is from 1 inch to 8 inches deep, is shown in figure 3. This portion contains from two to six newly formed bulbs, located at the base of the plant between the leaf layers of the old bulb. The old plant, that is, the stem and the leaves, then dies, leaving these new bulbs to start growth for the coming season. Figure 4 shows the plant illustrated in figure 3 with all the leaves removed, exposing the four bulbs which had been produced. The small detached bulb shown in the illustration was broken off from the dark spot at the base of the large bulb.

FIG. 2.—Aerial bulblets of the wild onion.

It will be noticed in figure 4 that three of these bulbs are small, while the one next to the stem is much larger. The large bulb has a thin, delicate, white skin, while the smaller ones have a hard brown shell around them. The large bulb always germinates in the summer or early fall. The hard-shelled bulbs do not start growth until a considerably later date. A few start in the late fall, but most of them remain dormant until the following spring or an even later period.

It has been found that before all the hard-shelled bulbs have germinated, plants from the soft-shelled bulbs have advanced far enough toward maturity to produce new bulbs. There is consequently an overlapping of generations, which is the secret of the remarkable persistence of this weed.

METHODS OF ERADICATION.

CULTIVATED LAND.

To kill the wild onion, the work must be started in the fall. The object of this work is to destroy the plants from the soft-shelled bulbs before they have advanced far enough to produce new bulbs. The best time is when the food stored in the bulb has been transferred to the growing plant and before the new bulbs have started to form. There is a considerable period when this condition exists, which is when the new plants are about 12 to 15 inches high. This

FIG. 3.—Underground portion of a wild onion at maturity.

FIG. 4.—Underground portion of the wild-onion plant shown in figure 3 with the leaf layers removed, showing the four new bulbs which this plant has produced.

is during October and November in the South and November and December in the North. When this stage has been reached, the land should be plowed fairly deep, turning under all the onion tops. This will dispose of these plants. If this plowing were put off until spring, however, these plants would have formed new bulbs, which would be able to grow even though the parent plants were destroyed. It is highly important that the tops be completely buried by the plowing; otherwise many of them would keep on growing. A plow with a jointer attached to the beam (fig. 5) will often be a great help in thoroughly turning under the tops, while disking the land previous to plowing will also aid in accomplishing this result.

The following spring the field should be planted to a cultivated crop. Corn, preferably planted in checkrows, is best. It may be necessary to plow again shallowly in the spring, but ordinarily a disking or two previous to planting will suffice. In cultivating the corn, the effort should be to kill the onion plants that spring up, and the easiest way of doing this is to cut off the tops. The best implements, therefore, are those that cut off all the tops instead of letting them slip through and keep on growing. Cultivators of the sweep type are best for this purpose. Figure 6 shows a number of implements of this kind. On many of the modern cultivators sweeps 9 to 18 inches wide may be quickly attached in place of the shovels. Some soils, of course, are too stony or otherwise unsuitable for the use of sweeps.

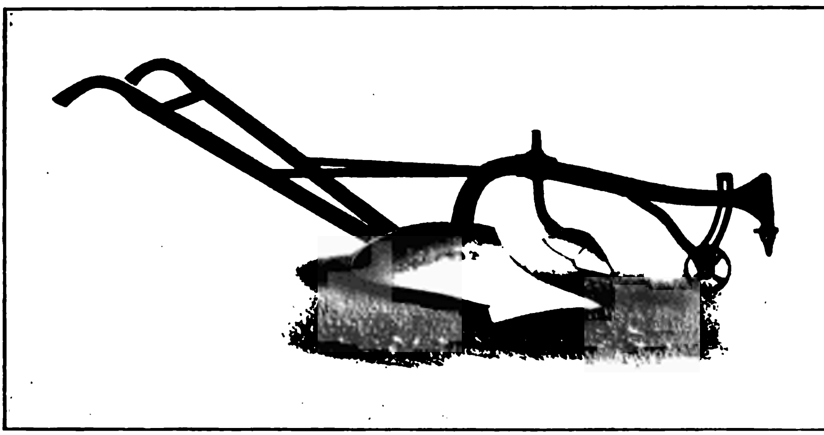

FIG. 5.—Plow with jointer.

From the time the farmer is able to get on the land in the spring until the corn is laid by, his efforts should be directed toward preventing the onion from making top growth. This spring and early-summer work is to kill the plants that come up from the hard-shelled bulbs. If it is well done, most of the onions will have disappeared by the end of summer. Some of the hard-shelled bulbs, however, may delay germination for a year or two, so that by fall a few plants may again be in evidence. Hence, the farmer should be prepared to follow the same plan of a deep plowing late in the fall, to be succeeded by a cultivated crop the next spring, giving careful cultivation to this crop. In two years this treatment is almost sure death to all the wild onions in the land, and the work can be carried out with but little extra labor and expense.

The aerial bulblets germinate in the early fall, like the soft-shelled bulbs, but the plants are weak and are readily destroyed by the fall plowing.

Many farmers have tried the method outlined here and have found it to be entirely satisfactory.

As a variation of the ordinary plowing some farmers have used trench plowing with success. This consists of running a plow about 4 or 5 inches deep and following this with another plow in the same furrow at a depth of 10 inches or more. The wild-onion plants and ungerminated bulbs being in the upper 4 or 5 inches are thus turned into a deep furrow and covered up by the second plow, burying them so that their tops can never reach the surface. In a soil of average depth, however, it is not desirable to turn up so much subsoil to the surface.

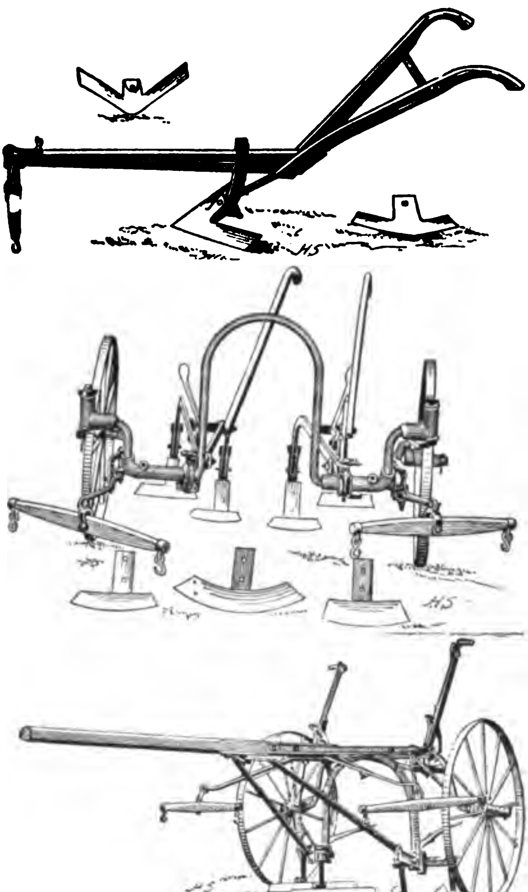

FIG. 6.—Various types of cultivators equipped with knives or sweeps that are effective in cutting off the tops of the wild onion.

PASTURES AND LAWNS.

If grass lands are quite full of the onion plants, the easiest way of disposing of them is to follow the cultivation method already outlined. There are many fields, though, where these weeds are not very numerous and where it would not pay to follow such a radical course.

The Department of Agriculture has experimented with various methods of killing each plant or group of plants in such situations. Treatments were tried out with a number of the most promising plant poisons, such as fuel oil, coal-tar creosote oil, arsenite of soda solution, and common salt. A small quantity of each of these poisons was applied to each plant or group of plants. While all these substances killed the plants, only one of them, namely, coal-tar creosote oil, affected the ungerminated bulbs as well. It was found that 10 cubic centimeters (about 4 thimblefuls) of this material was quite effective. The most feasible method for the average farmer, however, is to dig up the plants or clumps with a mattock. One well-directed stroke when the soil is moist and soft will take out the entire clump by the roots, including the ungerminated bulbs. This should be carried off, so as to give no further trouble. It is then a good plan, especially on a lawn, to fill the hole with soil and sprinkle a little grass seed on the surface.

Sheep eat the tops of the onion, and grazing for a few years is reported as an efficient remedy for the pest. The sheep apparently eat it to the greatest extent during the winter and early spring, when there is little other green vegetation in sight, or in poor pastures, where there is little to choose but the wild onion. On the better pastures it may be necessary to salt the onions occasionally to induce the sheep to get a taste sufficient to overcome their natural dislike for them. These animals may be of considerable help in reducing, and even finally eradicating, this pest in pastures.

MEASURES THAT HELP.

PREVENTING THE FORMATION OF BULBLETS.

As the aerial bulblets are practically the only means by which the onion pest is distributed from field to field and from farm to farm, it is highly important that the formation of the bulblets be prevented. If allowed to mature, they may be harvested with hay and grain and then carried to other parts of the farm. They are also carried by water and deposited on uninfested fields, where they propagate. Cutting the tops of the onion plants before they are ripe will prevent them from producing bulblets.

Late plowing for small grains.—It has been found that if plowing is delayed until a late date in the fall and the land is planted to small grain, only a few onion plants will ripen their aerial bulblets by harvest time the following summer. This late plowing disposes of those onion plants that start growth before plowing and gives the grain more than an even start with the garlic that begins growth after planting. As the plowing should be done at such a late date as to prevent the best development of fall-sown grains, it is preferable to plant spring grains. If circumstances require the sowing of fall grain, it should be done with the full knowledge that the necessarily late planting will probably reduce the yield. Seeding a fall-grain crop after late plowing has the least harmful effect on yield in the southern part of the onion belt, where wheat may be planted as late as November or December.

PREVENTING THE DISTRIBUTION OF BULBLETS.

If the bulblets have been permitted to mature it is important to prevent their further distribution. The most common method of distributing the wild onion is in small grain used for seed. Only grain free from the bulblets should be planted. Figure 7 shows wheat grains and onion bulblets as they appear at harvest time.

FIG. 7.—Wheat grains and newly matured wild-onion bulblets. Their similarity in size and shape makes separation difficult.

There are several practical methods for insuring onion-free seed wheat. Artificial drying makes the bulblets lighter and thus more easily fanned out; letting the grain stand a year accomplishes about the same result as artificial drying; if the bulblets are allowed to freeze, they afterwards become dry and can be readily fanned out; or, clean grain for seed may be purchased from some outside source. Another plan is to set aside a small area of land, free from onion, for producing seed grain. Since the quantity used to seed this patch is small, all the garlic bulblets can easily be removed by hand, if necessary.

WILD ONION AND MARKET WHEAT.

On boards of trade, wheat containing garlic bulblets in considerable quantity is graded "rejected" and is then sold only on sample. Such grain is generally sold at a price ranging from 20 to 50 per cent lower than No. 2 Red. Millers often refuse to handle onion-infested wheat, for they are able to grind it only at a much-increased cost. The bulblets gum the rollers, making it necessary to stop the mills frequently and wash the rollers before the grinding can be continued.

While the garlic bulblets become lighter and hence are more easily fanned out of wheat in from six months to a year after harvest, it is often impracticable to delay grinding for such a long period. In that case the infested grain may be artificially dried in a commercial grain drier, after which the bulblets may be easily removed by good cleaning machinery.

WILD ONION AND DAIRY PRODUCTS.

It is often feasible for the dairyman to eradicate this weed from his pasture, but until this eradication is accomplished he should follow such methods as will prevent losses from tainted milk. It has been found by the department that increasing the length of time between feeding on the onion and milking reduces the unpleasant odor and flavor. There is only a slight odor and flavor to milk when cows are kept off onion-infested pastures for four hours before milking, and even this slight flavor almost entirely disappears when the milk stands for four hours. At the present time this appears to be the most practicable method for reducing the onion flavor in milk.

SUMMARY.

To destroy wild-onion plants, plow deeply in the late fall, when the tops are a foot or more high. The tops should be thoroughly turned under. A jointer attached to the plow, as also disking previous to plowing, will help in this respect. The following spring the land should be prepared for a cultivated crop, corn in check rows being best. This crop should be given careful cultivation to keep down all the top growth of the garlic. If any onion plants persist the next fall, the method of late fall plowing, followed by a cultivated crop in the spring, should be repeated. This treatment will eradicate practically all the onion.

It is sometimes impracticable, for the time being, to eradicate this pest completely. In that case an important remedial method is to plant small grain late, plowing and preparing the land just before planting. While this will not destroy the onion, it gives it such a setback that the bulblets do not have time to mature before harvest, so that the grain is comparatively free from them. This method prevents the spread of the weed by means of the aerial bulblets.

Another remedial measure is to use for seed only such grain as is free from onion bulblets, since infested grain is one of the principal means by which this weed spreads.

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FARMERS' BULLETIN
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July 21, 1914.

THE AGRICULTURAL OUTLOOK.

CONTENTS.

TIME OF ISSUANCE AND SCOPE OF AUGUST CROP REPORTS.

The report showing the condition of the cotton crop on July 25 will be issued by the Bureau of Crop Estimates, Department of Agriculture, on Friday, July 31, at 12 noon (eastern time).

On Friday, August 7, at 2.15 p. m. (eastern time), there will be issued a summary of the conditions of the principal crops on August 1, which will give the following information: Preliminary estimate of yield and quality of winter wheat; condition on August 1 (or at time of harvest) of spring wheat, corn, oats, barley, potatoes, tobacco, flax, rice, apples; acreage and condition of buckwheat and hay; acreage, yield per acre, and quality of rye; stocks of oats in farmers' hands on August 1.

A supplemental report will be issued which will include a statement of the condition on August 1 of the following crops: Peaches, pears, grapes, watermelons, cantaloupes, sweet potaotes, tomatoes, cabbages, onions, beans, sugar beets, sugar cane, sorghum, peanuts, hops, broom corn, hemp, kafir corn, alfalfa, timothy, millet, blue grass (for seed); yield and quality of clover; also an index of general crop conditions on August 1 in each State; and the average price paid to producers for important products.

Details by States will appear in the August Agricultural Outlook.

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GENERAL REVIEW OF CROP CONDITIONS, JULY 1, 1914.

The composite condition of all crops of the United States on July 1, 1914, was about 1.4 per cent above their 10-year average condition on that date. Last year the July 1 condition of all crops was 1.7 per cent below the 10-year average, but prospects declined as the season advanced, the November, or final, reports last year being 6.7 per cent below the 10-year average. Consequently, present conditions are about 8.7 per cent better than the outturn of crops last year.

North Atlantic States.—General crop conditions on July 1 were 98.4 per cent of the average (not normal), being 102.3 in Maine, 105.7 in New Hampshire, 90.1 in Vermont, 95.0 in Massachusetts, 93.3 in Rhode Island, 96.3 in Connecticut, 99.4 in New York, 93.6 in New Jersey, and 98.3 in Pennsylvania.

Prospects declined somewhat during June; the precipitation, except in Maine and New Hampshire, was insufficient. Medium to poor conditions for hay, an important crop in this division, are the chief cause of underaverage prospects, and most crops are underaverages. Apple prospects, however, are above average.

South Atlantic States.—General crop conditions on July 1 in this division of States were 95.5 per cent of average, being 96.2 in Delaware, 99.8 in Maryland, 85.8 in Virginia, 87.0 in West Virginia, 95.9 in North Carolina, 99.5 in South Carolina, 98.0 in Georgia, and 93.5 in Florida.

The condition figure for the division is slightly lower than on June 1, notwithstanding a slight improvement in cotton.

Conditions in Virginia are lowest of all the States in the Union and West Virginia is next. Nearly all crops are low in conditions, the exceptions being cotton, wheat, and tree fruits. Tobacco, hay, oats, and potatoes are particularly low in condition. Drought is the chief cause. Some showers at the close of the month, however, were beneficial.

North Central States, east of the Mississippi River.—General crop conditions July 1 were 100.3 per cent of the average, being 99.4 in Ohio, 97.6 in Indiana, 96.4 in Illinois, 106.7 in Michigan, and 107.1 in Wisconsin.

In the northern part of this division rains have been propitious and crop prospects are excellent, but in the southern portion drought has curtailed prospects. Corn and wheat are above their average, but most other crops are below average.

North Central States, west of Mississippi River.—General crop conditions July 1 were 108.9 per cent of average, being 104.3 in Minnesota, 110.2 in Iowa, 93.5 in Missouri, 110.2 in North Dakota, 112.8 in South Dakota, 115.8 in Nebraska, 117.2 in Kansas.

This is the most favored section of the United States this season, every State except Missouri having prospects decidedly above their average. Drought and Hessian fly in wheat affected adversely crops in Missouri. In this division practically all crops are above average prospects.

South Central States.—General crop conditions July 1 were 96.0 per cent of average, being 88.2 in Kentucky, 90.9 in Tennessee, 100.9 in Alabama, 98.2 in Mississippi, 99.8 in Louisiana, 96.5 in Texas, 102.0 in Oklahoma, and 91.5 in Arkansas. Rainfall, until recently, has been deficient in the eastern portion and excessive in the western portion of this division. In Alabama the aggregate condition is above average owing to the favorable condition of cotton, as practically all other crops are below their average. Oklahoma's high general average is due to the excellent promise of wheat and oats.

Far Western States.—General crop conditions July 1 were 105.8 per cent of average, being 102.3 in Montana, 104.5 in Wyoming, 109.8 in Colorado, 109.7 in New Mexico, 98.4 in Arizona, 104.6 in Utah, 103.1 in Nevada, 99.7 in Idaho, 102.9 in Washington, 104.0 in Oregon, and 110.0 in California.

The Arizona condition falls slightly below average because the hay and winter wheat crops were moderately below average. In Idaho most crops are near their average, potatoes falling the most below. The apple prospect in this division is somewhat below average; most crops, however, are above average. In California, hops, prunes, and walnuts, out of 20 crops reported upon, show less than average condition.

TABLE 1.—*Growing condition of the various crops on July 1, expressed in percentage of their 10-year averages (not the normal) on July 1.*

Winter wheat	117.3	Rye	103.8	Raspberries	100.4	Sorghum	93.3
Pears	110.0	Grapes	103.5	Peaches	99.3	Blackberries	91.3
Barley	109.7	Hops	103.2	Hay	98.7	Sugar cane	91.2
Spring wheat	109.1	Sugar beets	103.1	Cotton	98.6	Lima beans	90.9
Apples	108.1	Broom corn	102.7	Rice	98.3	Tomatoes	89.3
Kafir corn	107.9	Corn	101.3	Onions	95.4	Timothy hay	88.4
Alfalfa	106.6	Oats	101.0	Potatoes	94.3	Sweet potatoes	88.3
Lemons	104.9	Cantaloupes	101.0	Pasture	93.7	Hemp	87.6
Oranges	104.6	Beans (dry)	100.8	Peanuts	93.5	Clover hay	85.1
Flax	104.3	Millet	100.7	Cabbages	93.3	Tobacco	78.0

THE WHEAT PROSPECTS.

The July 1 forecast of this year's wheat crop of the United States is 930,000,000 bushels, the largest ever produced, exceeding last year's crop, which was itself a record crop, by about 167,000,000 bushels. The third crop in size is that of 1901, when 748,000,000 bushels was the estimate. The average production of the past 5 years was 686,000,000 bushels.

Such a large crop would augur very low prices were it not that the world crops of wheat and competing grains do not promise more than about the average of recent years. Also that more than the usual diversion of wheat from its use as food to the use of feed for live stock may be expected, owing to the present relatively short supply of corn in some sections where there is a promise of abundant wheat. On July 1 the price of corn in Kansas averaged 77 cents per bushel of 56 pounds and the price of wheat averaged 70 cents per bushel of 60 pounds; thus the price of corn was actually higher than that of wheat. In the past 5 years the price of wheat in Kansas on July 1 has averaged 92 cents and corn 64 cents. Somewhat similar conditions prevail in other States. Under such conditions it is not surprising that much wheat should be consumed as feed by animals. The corn crop of Kansas last year was only 23,000,000 bushels; its usual production is nearly 150,000,000. The corn crop now growing will not be available for 4 to 5 months. The present wheat crop in Kansas is expected to produce over 150,000,000 bushels, or nearly twice the average production.

Last April crop reporters of the Bureau of Crop Estimates, in Kansas, estimated that 12.6 per cent of last year's wheat crop would be consumed by live stock, in Nebraska 14.7 per cent, in Oklahoma 21.0 per cent, and in Missouri 14.4. These figures indicated that nearly 30,000,000 bushels of last year's wheat crop in the States named were used for animal feed, and it was inferred that in the whole United States 40,000,000 to 45,000,000 bushels of last year's wheat crop was consumed as animal feed.

Of the average annual production of 686,000,000 bushels of wheat during the past 5 years, about 581,000,000 were retained in the United States and 105,000,000 exported; that is, the yearly average of the past 5 years. During the past year, ending June 30, about 145,000,000 bushels were exported, nearly 30 per cent in the form of flour.

It is customary to reckon the domestic wheat requirements at about 5.3 bushels per capita, exclusive of seed, and 75,000,000 to 80,000,000 bushels for seed. If this per capita rate be applied to a population of 98,781,000 it would indicate a normal requirement of 523,539,000 bushels, plus seed requirement of 77,000,000, or a total of about 600,000,000. This would indicate an available export supply from the crop of nearly 330,000,000 bushels; but there must be deducted from this amount whatever quantity is used in an unusual way for live-stock feeding, which amount, although an unknown quantity, may readily be placed at approximately 75,000,000 bushels, and maybe more. Even this would leave about 255,000,000 bushels for export. The largest amount ever exported from the United States in one year was 234,000,000 bushels in 1901, when the crop was nearly 750,000,000 bushels. The decade of the nineties was the palmy period of wheat-export business. During the decade of the seventies (beginning with 1870) wheat exports averaged 86,000,000 bushels yearly; in the eighties, 127,000,000 bushels; in the nineties, 173,000,000 bushels; in the first decade of this century, 143,000,000 bushels; and in the past four years, 109,000,000 bushels.

Present indications are that during the coming season the domestic consumption will be unusually large, on account of takings for live-stock purposes, and that the exportable surplus will find a good foreign demand. The quality of the grain promises to be very good, because usually the quality is good when the yield is heavy.

OUTLOOK FOR THE 1914 FOREIGN WHEAT CROP.

Although a sufficient proportion of the foreign wheat crops has not yet been harvested to indicate whether or not the aggregate result is likely to exceed the bumper total of last year, preliminary reports from winter-wheat growing countries, whose harvests are either finished or which will take place within the next few weeks, point to a considerable deficiency of this variety, as compared with the preceding season. Spring wheat, however, which ordinarily constitutes over one-fourth of the world's annual supply, has yet to pass through critical stages of development, and uncertainty respecting the outcome renders all present calculations as to the total of both varieties vague and indecisive.

In the great majority of countries abroad the 1913–14 season has from various causes been more or less unfavorable to full yields of winter wheat. From the harvests which took place in Argentina, Australia, and British India in the winter and spring, the combined outturn fell short of that of the previous year by 105,000,000 bushels, Australia alone showing an increase. The quantity subsequently harvested in North Africa is believed to have been much below expectations, because of drought in Algeria and Tunis. In Europe the yield in no important winter-wheat country, excepting Russia, promises to exceed materially that of a year ago, and in a few countries heavy decreases have already been recorded. A preliminary official estimate puts the yield of Italy at 180,042,000 bushels against 214,405,000 in 1913, a falling off of close to 35,000,000 bushels. The Hungarian crop, according to an official estimate based on the appearance of the plants in mid-June, indicates a decrease in that Kingdom of 18,000,000 bushels, the official forecast for 1914 being 133,488,000 bushels from 8,623,000 acres, compared with 151,346,000 bushels in 1913 from 7,699,838 acres and 173,328,000 bushels in 1912. In Russia winter wheat constitutes roughly about one-fourth the total wheat, the bulk of the crop being of the spring variety. A recently published estimate of the Central Statistical Committee makes the 1914 acreage of winter wheat in 63 governments of European Russia 18,212,000 acres against 17,293,000 acres last season, and the production of the current year 297,044,000 bushels, compared with 295,453,000 bushels in 1913—an increase for the present season of 1,600,000 bushels.

Definite official figures on winter-wheat yields in 1914 have as yet been issued for no other countries of Europe. Reports on the condition of the crops from time to time since the opening of spring have, however, frequently indicated unseasonably low temperatures and alternate periods of excessive drought or moisture over wide areas. During the past two weeks weather conditions have improved pretty generally and more optimism is expressed regarding the outcome of winter wheat, both as to quantity and quality, than was heard earlier in the season. Improvement in condition is reported from the United Kingdom, France, Germany, Austria-Hungary, Roumania, Russia, and some smaller producing nations, but in most quarters the popular impression is that the change of weather will benefit quality more than quantity.

Spring wheat, of which the bulk of the foreign supply is produced in Canada and Russia, seems, with a few possibly important exceptions, to have made satisfactory development. The Canadian crop, as a whole, is said to have been sown in an exceptionally well-prepared seed bed, and the seed to have had unusually good germinative quality. Growth, notwithstanding occasional spells of local drought, has made fine progress during the season and prospects of yields are now generally described in superlatives. Concerning the important Russian crop, there have been the past month numerous contradictory and confusing reports. Perhaps the most certain conclusion to be derived from them is that extensive drought has prevailed at times in some sections of the Empire, especially in the center, but the extent of the damage, if any, has not yet been given statistical expression.

COTTON ACREAGE AND CONDITION JULY 1.

The Crop Reporting Board of the Bureau of Crop Estimates (formerly Bureau of Statistics) of the United States Department of Agriculture estimates, from the reports of the correspondents and agents of the Bureau, that the area of cotton in cultivation this year (1914) in the United States is about 36,960,000 acres, as compared with 37,458,000 acres, the revised estimates of acreage in cultivation a year ago, being a decrease of 498,000 acres, or 1.3 per cent.

The condition of the growing crop on June 25 was 79.6 per cent of a normal condition, as compared with 74.3 on May 25, 1914, 81.8 on June 25, 1913, and 80.7, the average condition for the past 10 years on June 25.

Details by States follow:

States.	Area under cultivation a year ago (revised estimate).	Area, 1914 (preliminary estimate).		Condition.			
		Per cent compared with 1913.	Acres.	June 25, 1914.	May 25, 1914.	June 25— 1913.	June 25— 10-year average.
Virginia	48,000	96	46,000	86	83	81	84
North Carolina	1,589,000	100	1,589,000	82	76	76	81
South Carolina	2,798,000	101	2,826,000	81	72	73	79
Georgia	5,345,000	101	5,398,000	83	80	74	81
Florida	192,000	101	194,000	86	82	85	85
Alabama	3,798,000	103	3,912,000	88	85	79	80
Mississippi	3,117,000	101	3,148,000	81	87	82	78
Louisiana	1,263,000	110	1,389,000	81	82	81	78
Texas	12,686,000	95	12,052,000	74	65	86	82
Arkansas	2,527,000	100	2,527,000	80	79	86	81
Tennessee	866,000	100	866,000	79	80	87	83
Missouri	113,000	110	124,000	93	86	88	83
Oklahoma	3,102,000	92	2,854,000	79	68	89	82
California	14,000	250	35,000	100	100	95	97
United States	37,458,000	98.7	36,960,000	79.6	74.3	81.8	80.7

TOBACCO REPORT, BY TYPES AND DISTRICTS, 1914.

Table 2 shows the preliminary acreage and condition of tobacco on July 1, by types and districts.

TABLE 2.—*Tobacco acreage, by types and districts, 1914, and condition July 1.*

Type and district.	Area, 1914.	Per cent of 1913.	Condition, July 1— 1914	Condition, July 1— 1913	Condition, July 1— 5-year average.
I. *Cigar type.*	*Acres.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
New England	27,000	109	93	95	95
New York	4,600	106	95	92	93
Pennsylvania	33,100	85	86	83	90
Ohio: Miami Valley	56,400	110	75	87	90
Wisconsin	45,600	106	98	95	92
Georgia and Florida	6,200	108	77	90	90
II. *Chewing, smoking, snuff, and export types.*					
Burley district	244,200	105	68	82	83
Paducah district	61,500	82	55	70	81
Henderson or Stemming district	71,500	130	60	69	83
One-Sucker district	38,400	100	64	69	78
Clarksville and Hopkinsville district	98,900	86	60	74	82
Virginia Sun-Cured district	11,900	75	53	80	82
Virginia Dark district	49,800	70	52	89	86
Old Bright district	216,000	90	59	91	81
New Bright district	151,800	92	62	85	78
Maryland and Eastern Ohio export district	22,900	83	78	78	86
Louisiana: Perique	700	110	91	95	86
All other	10,500	....	....	....	....

The total area of cigar tobacco is 172,900 acres, compared with 168,000 in 1913, an increase of 4,900 acres, or 2.9 per cent. Pennsylvania is the only State showing a decrease. New Hampshire and

Vermont, each State growing only about 100 acres, show the same as last year. All other States have a larger area. The chewing, smoking, snuff, and export types show 967,600 acres, against 1,036,300 in 1913, a decrease of 68,700 acres, or 6.6 per cent. The total area is 1,151,000 acres, compared with 1,216,100 acres last year, or 5.4 per cent less.

I. CIGAR TYPES.

New England.—The area is 9 per cent larger than last year. With an abundant supply of plants and favorable weather the crop was transferred to the fields about the usual time under favorable conditions. More damage than usual was done in the fields by wireworms, but this was overcome by replanting and a good stand secured. The condition on July 1 indicated a good crop.

New York.—The acreage has been increased 6 per cent. Plants were plentiful and in the Onondaga district 10 days or two weeks early, and transplanting also was early. In the Big Flats district planting was at about the usual time. Some damage to plants in the field by insects is reported, but with favorable soil conditions for replanting a good stand was secured. The condition on July 1 was better than it was last year and promised a good crop.

Pennsylvania.—Low prices and poor returns for last year's crop caused a reduction of 15 per cent in the area planted. Plants were plentiful and were transplanted early. Some damage from cutworms is reported, but this did not prevent a good stand. Condition on July 1 indicated a much better crop than in 1913.

Ohio: Miami Valley.—The acreage has been increased 10 per cent. Plants were abundant and early, and planting began in good time, a part of it early. Dry, hot weather made a stand hard to secure, delayed transplanting the latter part of the crop, and interfered with growth of that planted. Condition on July 1 was not good, but will improve rapidly with rains.

Wisconsin.—The acreage is 6 per cent larger than last year. Plants were plentiful and transplanting was accomplished a week or 10 days early, and a good stand secured. The high condition reported on July 1 gives promise of the best results in several years.

Georgia and Florida.—The acreage is 8 per cent larger than last year. Plants were late and planting began later than usual, but under favorable conditions was pushed rapidly and finished about the usual time. Dry weather following caused some apprehension as to the outcome. More favorable conditions later give promise of good quality.

II. CHEWING, SMOKING, SNUFF, AND EXPORT TYPES.

Burley district.—The acreage is 5 per cent larger than in 1913. A larger increase was intended, but dry weather in some portions of the district prevented the full acreage being planted.

Plants were abundant and ready about the usual time, but transplanting was delayed by hot, dry weather and began late. Where the rainfall was sufficient the full intended acreage was planted and a good stand secured. In parts of the district the land was dry and with only light local rains a full acreage was not planted and the stand is bad. Dry weather followed planting and interfered with proper growth. The crop is late and does not promise good quality or yield.

Paducah district.—A much larger area than last year's was prepared and plants were plentiful and early, but extremely hot, dry weather, relieved only by local showers, prevailed during the planting season and only 82 per cent of last year's acreage was planted, two or three weeks late. The stand is bad and condition poorest for several years. Dry weather continued up to July 1 and the crop is a month late. A crop poor in quality and short in pounds is indicated.

Henderson or Stemming district.—The acreage is 30 per cent larger than last year's, but smaller than intended. Plants were plentiful and ready for transplanting about the usual time. Hot, dry weather, with only local showers, made conditions unfavorable and the area prepared was not all planted. The stand is poor and growth three or four weeks late. The prospect on July 1 was for a light yield of inferior quality.

One-Sucker district.—This district has formerly been reported under the head of the Upper Green River and Upper Cumberland districts. The area is about the same as it was last year, but less than intended. With an abundance of plants, they could not be transplanted at the usual time on account of hot weather and the dry condition of the soil. Local rains gave some relief and a part of the planting was accomplished three weeks late. The stand is poor and the condition on July 1 did not indicate good results.

Clarksville and Hopkinsville district.—The area is 14 per cent less than last year's, although an increase was planned. With no general rain from early in May until July 1, planting was not completed and what was accomplished was late. The stand is poor and growth a month late. The condition on July 1 indicated a light yield of poor quality.

Virginia Sun-Cured district.—The area is 25 per cent less than last year's, caused partly by low prices and unsatisfactory returns and partly by dry weather, which prevented the full planting of the intended area. Plants were scarce and late and planting was delayed by dry weather. The stand is bad and growth poor, and a good yield is not indicated by the condition on July 1.

Virginia Dark district.—The area is 30 per cent less than in 1913, partly because growers in the eastern end of the district substituted bright tobacco for dark. Plants were 10 days or 2 weeks late and scarce on account of damage in beds from flies. Planting was delayed by hot, dry weather, and in some instances not fully accomplished. The stand is poor and growth late, giving promise of poor results.

Old Bright district.—The acreage is 10 per cent less than last year's, whereas about that much increase was intended. Planting was delayed a week or 10 days by the lateness of plants and further by dry, hot weather, and in some instances land prepared for tobacco was not planted. The stand is poor and crop late. July 1 condition indicates a short crop.

New Bright district.—The area is 8 per cent less than it was last year, but an increase was planned. A freeze early in March killed most of the plants in the beds, necessitating resowing and causing plants to be two weeks late. Dry, hot weather followed, further delaying planting, so that it was a month late, and in some instances tobacco land was planted in other crops. The stand is bad, but a good crop possible under favorable conditions.

Maryland and Eastern Ohio Export district.—The area has been reduced 17 per cent, while under favorable conditions a small increase would have been planted. Plants were abundant, but dry, hot weather delayed planting and reduced the area; the growth is late and stand bad. A good crop is not promised.

Louisiana: Perique.—The area is larger and a crop above the average in yield and quality is promised.

The receipts of butter and eggs at six primary markets for June, 1914, were: Butter, 65,567,459 pounds; eggs, 1,143,136 cases. The average receipts for June during the 5 years 1910–1914 were: Butter, 64,411,410 pounds; eggs, 1,211,453 cases.

AREA OF SUGAR BEETS PLANTED, 1914.

The area of sugar beets planted in 1914 was 18 per cent less than in 1913, and amounted to about 520,600 acres. In Idaho and Utah a greater area was planted this year than last year, but in the other States there was a decrease. The area harvested for 1913 was about 91 per cent of the area planted for the entire United States. Table 3 shows in detail the area planted in the current year, and both planted and harvested acreage last year:

TABLE 3.—*Area of sugar beets planted in 1914 and 1913, and area harvested in 1913.*

State.	Area planted. 1914 Percentage of 1913.	Area planted. 1914 Amount.	Area planted. 1913	Area harvested, 1913. Amount.	Area harvested, 1913. Percentage of planted area, 1913.
	Per cent.	*Acres.*	*Acres.*	*Acres.*	*Per cent.*
California	79	109,500	138,300	127,610	92
Colorado	80	146,100	183,100	168,410	92
Idaho	111	25,900	23,300	22,497	97
Michigan	91	111,300	122,600	107,965	88
Ohio	61	19,000	31,200	30,661	98
Utah	103	41,900	40,600	39,472	97
Other States	70	66,900	96,000	83,391	87
United States	82	520,600	635,100	580,006	91

The average price paid to growers for sugar beets in 1913 was $5.69 per ton. The average given in the May issue of the Agricultural Outlook (Farmers' Bulletin 598, p. 10) was an error.

FLORIDA AND CALIFORNIA CROP REPORT.

TABLE 4.—*Crop conditions in Florida and California.*

Crop.	Florida. Condition July 1— 1914	Florida. Condition July 1— 1913	Florida. Condition July 1— 1912	Florida. Condition June 1.	California. Condition July 1— 1914	California. Condition July 1— 1913	California. Condition July 1— 1912	California. Condition June 1.
Pineapples	70	91	95	75				
Oranges	90	89	95	82	89	70	80	92
Lemons					90	57	83	87
Limes	90	84	85	86				
Grapefruit	90	85	90	84				
Peaches	75	50	90	72	85	69	84	85
Pears	67	38	45	70	82	71	81	80
Watermelons	74	80	80	76	93	85	89	95
Cantaloupes	68	77	70	68	95	86	90	96
Apricots					77	60	80	80
Prunes					70	74	85	65
Olives					90	78	88	92
Almonds					81	55	80	85
Walnuts					83	83	90	86
Velvet beans	84			82				
Grapes:								
For wine					94	89	95	
For raisins					92	89	96	
For table					96	89	95	

Exports of Sea Island cotton from the United States for the 9 months ending March 31, 1914, were 7,061,209 pounds, and exports of other cotton amounted to 4,193,226,574 pounds, according to the U. S. Department of Commerce. For the corresponding 9 months of the preceding fiscal year exports of Sea Island cotton were 2,219,039 pounds and other cotton 3,927,242,266.

TREND OF PRICES OF FARM PRODUCTS.

The level of prices paid producers of the United States for the principal crops decreased about 0.8 per cent during June; in the past 6 years the price level has increased during June 0.4 per cent.

On July 1 the index figure of crop prices was about 12.0 per cent higher than a year ago, but 14.0 per cent lower than 2 years ago and 1.3 per cent lower than the average of the past 6 years on July 1.

The level of prices paid to producers of the United States for meat animals decreased 1.0 per cent during the month from May 15 to June 15, which compares with an increase of 1.6 per cent in the same period a year ago, a decrease of 2.0 per cent 2 years ago, a decrease of 1.7 per cent 3 years ago, and a decrease of 1.1 per cent 4 years ago.

From December 15 to June 15 the advance in prices for meat animals has been 5.4 per cent; whereas during the same period a year ago the advance was 12.0 per cent, and 2 years ago 16.8 per cent, while 3 years ago there was a decline in price of 12.3 per cent during this period.

On June 15 the average (weighted) price of meat animals—hogs, cattle, sheep, and chickens—was $7.22 per 100 pounds, which is 0.5 per cent higher than the prevailing price a year ago, 15.2 per cent higher than 2 years ago, 32.6 per cent higher than 3 years ago, and 0.9 per cent lower than 4 years ago on June 15.

A tabulation of prices is shown on pages 36 and 37.

HESSIAN FLY.

By F. M. WEBSTER, *In Charge of Cereal and Forage Insect Investigations.*

The Hessian fly is a true fly, having but a single pair of wings. In form it somewhat resembles a diminutive mosquito. The term "Hessian fly" was long ago applied to it on account of its having been discovered some time after the encampment of the Hessian troops on Long Island, New York, in 1779. While it is, beyond a doubt, a foreign insect, it may or may not have been introduced in this manner. Be that as it may, it has spread continuously throughout the wheat-growing regions of the eastern United States from the Atlantic coast westward to central North Dakota and South Dakota, central Nebraska, western Kansas, and northeastern Oklahoma; also along the Pacific coast west of the Sierra Nevadas, thus occupying only the more humid portions of the country, apparently being unable to develop in an arid country. It is for this reason, probably, that it does not occur continuously to the west of longitude 100° or to any great extent southward beyond a few miles from the Arkansas River; while, of course, east of the Mississippi it is restricted only by the area covered by the limits of the wheat-growing section. (Fig. 1.)

There are two annual generations of the pest. What may be termed the first generation of flies, enumerating them chronologically, appears in spring, originating from "flaxseeds," so called, in plants that have been attacked the previous autumn. These flies, as is the habit of those of both generations, deposit their slender, minute eggs of a reddish color in the troughs or furrows of the leaves of wheat. The young maggots hatching from these eggs are equally minute, of the same reddish cast as the eggs, and make their way down the leaf to the sheath and between this and the stem, usually to the first joint below.

The young maggot gradually changes to white, and when nearly mature in this stage to a glassy green clouded with white. As it

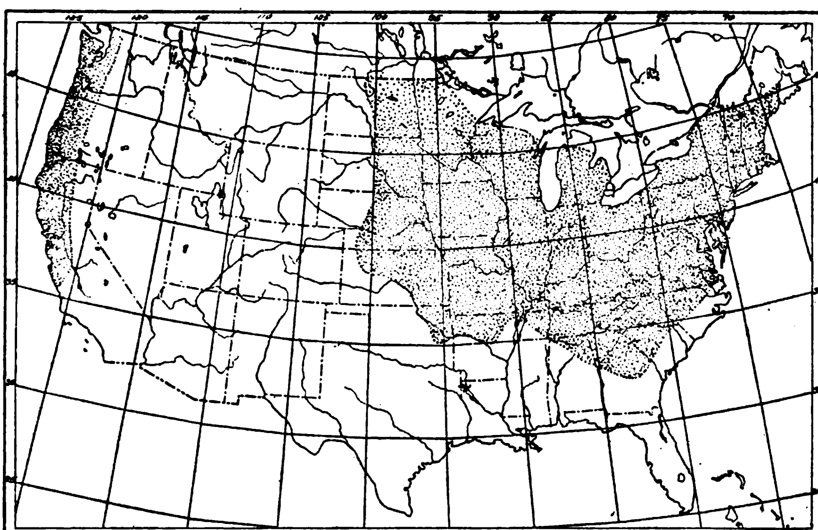

FIG. 1.—Map showing distribution of Hessian fly in the United States.

increases in size it becomes embedded in the juicy stem, causing a weakening of the straw at this point, resulting in straw-fallen grain just before harvest.

When the maggot has become full sized the skin covering gradually hardens and changes to somewhat the color and appearance of a flax-seed, so much so that this stage, which is between the maggot and the fly, is commonly called the "flaxseed" stage. Sometimes these "flaxseeds" are found just above the ground, sometimes higher up the stem, the exact location depending on the size of the wheat plants at the time the eggs were deposited in the spring. Some farmers mistake them for the eggs. By harvest nearly all of the maggots have passed into what we know as the "flaxseed" stage, which is a resting stage, during which no food is required.

The period through which the insect remains in this stage varies, first, with the latitude, and, second, with humidity and rainfall; thus, in the northern portion of the country the adult flies emerge from these flaxseeds in the stubble early in September, probably about the 10th or 15th; whereas in the extreme southern portion of the country they do not appear until a month or six weeks later. Besides, the same weather conditions that prevent the young wheat from starting in fall retards the appearance of the fly. The fly is short lived and must deposit its eggs soon after it emerges from the stubble. It is a mistaken idea that frost destroys it.

East of the Mississippi River the fly is not known to develop in the grasses, so that the summer may be said to be passed exclusively in the grain stubble. West of the Mississippi River, under certain conditions, it may develop and pass the summer in some of the grasses. If, at the time the flies are abroad in the fall, there are no wheat plants above ground on which the female flies can deposit their eggs, there can be no injury to the plants in the fall, and hence none the following spring; whereas, if the wheat is sown early enough so that the plants have made some growth above ground at the time the eggs are deposited, the flies will seek out these plants and they become infested in the same way as the plants in the spring, only in the fall the young maggots hatching from eggs deposited on the wheat leaves make their way down behind the sheath to a point just above the roots of the plant, where they become embedded in the tissue, precisely as is the case in the spring, only lower down the plant.

The effect of the fly on young wheat in the fall is exceedingly deceiving, the infested plants being of a more rank growth, the leaves broader and of a darker color, almost resembling those of oats; but close examination will show that there is no central leaf or portion of the plant that would later become the stem or straw. Thus it is that wheat fields may appear unusually vigorous and healthy until quite late in the season, when, suddenly, the plants change color and die. The most of the maggots become full grown before cold weather occurs and pass the winter in the brown or "flaxseed" stage, and it is from these "flaxseeds" that the flies emerge the following spring.

The logical conclusion therefore must be that if the farmer will delay his wheat sowing until after the adult flies have appeared and disappeared in the fall there will be none in his fields to winter over and produce flies the following spring; in other words, the farmer has but one opportunity during the year to reach this pest, and that is at the time he sows his grain. It is entirely possible and frequently occurs that a few early sown fields will in spring infest a whole neighborhood, regardless of whether it was sown late or early.

Strange as it may seem, the methods of dealing with this pest will appear far-fetched and require some explanation to show why they in any way relate to the pest or its control.

The first move should be to procure a well-pulverized, fertile, compact seed bed. This may, perhaps, be best explained by suggesting that the farmer commence to plow his ground early, just as though he expected to sow very early. Then cultivate it continually, by disking or rolling, as may become necessary, until he gets a thoroughly pulverized compact bed in which to place the seed. The sowing may then be delayed later than ordinary, because when the seed is placed in the ground it has every favorable condition to enable it to germinate quickly and send out rootlets to supply prompt and sufficient nourishment for the young plants.

It must be borne in mind that a healthy, vigorous plant will throw off or outgrow an attack that would kill a weaker one. Again, if the wheat is sown year after year on the same land, the flies have but to emerge from the old stubble and deposit their eggs upon the young wheat plants, whereas, on the other hand, if the crop is rotated and the wheat is fall sown upon land that has produced some other crop, then the fly must migrate or be carried with the wind from one field to another, which, owing to their frailty, always proves more or less fatal. It will be seen that good farming and a rotation of crops are two practical and efficient measures in controlling the Hessian fly.

As to the time when the farmer should sow his grain to escape the fall attack, he can of all others best decide this matter for himself, because, if he will watch year after year, he will soon notice that wheat sown after about a certain date will rarely be infested by fly and then more generally in spring, which infestation may have come from some early-sown fields in his neighborhood.

In case of the present outbreak, generally speaking, the farmer can get no better indication of the date when he should sow his grain in the fall of the year than to follow the infestation as shown by the sowing of the fall of 1913. In many localities farmers have reported that wheat sown after certain dates was uninjured, while that sown previously was damaged from 50 to 75 per cent.

A long series of wheat-sowing experiments covering a period of over a quarter of a century, outlined by the writer and carried out by practical farmers, has clearly shown that wheat should not be sown in the fall in the latitude of southern New York, southern Michigan, southern Wisconsin and westward much, if any, before the 20th of September; in the approximate latitude of Philadelphia, Pa., Columbus, Ohio, Indianapolis, Ind., Springfield, Ill., and extreme northern Kansas, before the 25th of September; while in northern Maryland, extreme southern Ohio, southern Indiana, southern Illinois, and southern Kansas it should not be sown before October. Not only do the results of experiment show this, but those obtained by practical successful farmers have proven their correctness. In extreme southern Kansas and northern Oklahoma wheat should not be sown until after the first week in October; and this is true of Virginia. October-sown wheat always enjoys the greatest freedom from fly in Maryland. Practically the same corresponding delay in wheat sowing in the fall should be followed to the southward.

There are numbers of natural enemies of the Hessian fly and serious outbreaks are doubtless primarily due to the fact that, owing to conditions not well understood, possibly meteorological, these natural enemies become so reduced as not to be able to control the pest.

From the fact that many successful farmers rarely or never lose a crop of wheat from Hessian fly attack, it is very clear that the results they obtain can also be accomplished by others. If the soil lacks fertility, some quick-acting fertilizer applied at the time of sowing will encourage and facilitate the rapid growth of the wheat plants, and thus some of the objections to late sowing be overcome.

MARKETING BY PARCEL POST.

By Charles J. Brand, *Chief, Office of Markets.*

There is a great diversity of opinion as to the benefits that will come to producers through the inauguration of the parcel post. Some are greatly pleased with the prospect of direct marketing of such products as lend themselves to proper distribution by this means and already are availing themselves of the facilities that have been provided. Others see nothing hopeful or promising in the parcel-post system and usually have not tried it at all or have tried it in a very inadequate fashion and without due attention to the many important details of successful marketing in this manner.

It is important to remember that there is nothing automatic about the parcel post. It is merely a vehicle for the transportation and delivery of produce, the successful development of which will depend very largely upon the shipper, though also in part on the purchaser or consumer. This presumes, and with the best of reason, that the Post Office Department will do its part of the work with dispatch and care.

As a method of marketing the parcel post will succeed only in such measure as it accomplishes more efficiently and economically the functions performed by the numerous middle interests of the present system. Its greatest advantage naturally will appear, so far as shipments from the farm are concerned, in those commodities which are produced practically in the condition in which they are finally retailed to the consumer, but even in the case of such products there must be a well-understood and businesslike agreement as to how fair and reasonable prices are to be arrived at and as to the particular qualities that are to be delivered at the stated prices.

There is an unfortunate tendency on the part of some farmers who have butter, eggs, and other produce to sell to ask prices far above those current in their own rural localities and higher even than those exacted by the fancy retail stores of the cities for products of the same grade. Fundamentally there are only two reasons to persuade the consumer to undertake the additional trouble and uncertainty of securing produce by mail. These are economy in cost and greater freshness of product. No unusual method will ever be popular unless it gives results along one or both of these lines. Producers must be very careful not to overreach in the matter of price. Unless they are willing to share the saving with the consumer who agrees to receive food products which he has not had an opportunity to examine and whose quality and time of delivery will always be subject to a degree of uncertainty, there is little prospect of the wide extension of the parcel-post system which it deserves, so far as the farm is concerned.

Recently the post office at Washington, D. C., has been very active in trying to promote parcel-post marketing, collecting lists of names of farmers and others who have produce to sell, and printing and distributing these lists to patrons of the Washington office who might become purchasers. A few cases with respect to eggs alone will suffice to illustrate this tendency referred to above. One New Jersey farmer offers eggs at 40 cents a dozen the year around; a Pennsylvania farmer in June offers "fresh white sanitary eggs" at $1 for two dozen; a Virginia farmer offers eggs at Washington quotations plus 10 cents. It is difficult to see how a user of eggs could afford to pay such prices when fresh country eggs are being sold by farmers to country grocers at this moment for prices ranging above and below 20 cents a dozen in trade.

The difference between the country price and the city price must be shared fairly between the producer and the buyer. The latter will not take chances on things that can not be examined and which in some cases may not fulfill the particular need; furthermore, he will not bear the uncertainty as to time of arrival unless there is a gain to him in so doing. On the other hand, much of the consumers' particularity is based on illogical prejudice, so that they, as well as the producers, must standardize their demands and make concessions.

Standardization of products is one of the essential things to parcel-post marketing. Uniformity in quality is almost as important as high quality. It is likely that the most satisfactory way to make progress along these lines is through the preparation of descriptive specifications for those kinds of produce that will be marketed most largely through parcel post. Only by some such means can the necessary protection be afforded the purchaser as to quality and the producer as to price.

The Office of Markets of the U. S. Department of Agriculture is engaged in a study of standardization which will enable it to publish such grade descriptions as will facilitate ready intercourse.

Farmers should remember that the parcel post works both ways. It is just as useful in having things sent to the farm as in sending products away from the farm. Those who have not tested it as a means of securing things to supply their own needs will be surprised at the convenience and delight of having orders which can be placed by postal card or telephone delivered at the rural free-delivery box in front of the farm.

The practicability of shipping perishable produce is not open to serious question. For many years the investigators in the Department of Agriculture concerned in the introduction, breeding, improvement, and general study of all kinds of fruits, vegetables, and other plants have utilized the mails in the shipping of experimental material. In this way everything from the most delicate fruits to vegetables suitable for all winter storage have been shipped from a few miles to several thousand miles. In a great majority of cases, packages and packing have been devised after a few trials which have resulted in delivery in good condition. More recently, definite and carefully planned experiments covering eggs, butter, strawberries, cherries, lettuce, and assorted vegetables have been undertaken.

The tests that have been conducted in the shipping of eggs are described in Farmers' Bulletin No. 594, entitled "Shipping Eggs by Parcel Post," which can be obtained free of charge upon application to the Division of Publications, Department of Agriculture, Washington, D. C. During the progress of this experiment, and since that time, over 10,000 eggs have been shipped with a loss small enough to constitute a thorough practical demonstration favorable to the method. In the bulletin detailed instructions are given by means of which any farm operator, his wife, or older children could make a beginning in the establishment of a parcel-post egg market. Indeed, many cases of permanent arrangements between producers and consumers whereby shipments have been made regularly for a period of months have already been made. From October of last year to June of the present year the writer secured practically his whole supply from a farm 92 miles distant from Washington, involving a transfer point for all mail. Only two cases of breakage in sufficient quantity to be worthy of comment occurred.

There are numerous types of containers, several of which have proven satisfactory, concerning which information may be obtained by interested persons by applying to the experiment stations in their respective States.

Extensive experiments in the shipping of butter by parcel post have been under way for a number of months. No shipments of less than 2 pounds are made because of the relatively greater expense incident to the shipment of single pounds. It has been sent in 2, 3, 5, and 10 pound parcels, not only from the creameries at which it was produced to the office in Washington, but from Washington to experiment stations throughout the country for examination there and subsequent return. The butter used has been all put up in 1-pound prints, wrapped in regular waterproof butter paper, and placed in paraffined paper cartons such as are most commonly used in the distribution of fancy creamery butter. These cartons are then inserted into corrugated pasteboard containers suitable for accomodating the differing amounts to be shipped, and wrapped with good wrapping paper.

Under ordinary weather conditions practically no difficulty has been experienced in the shipment of butter. The chief problem to be solved, of course, is to prevent the butter from liquefying; mere softening has not proven injurious. The difficulty is somewhat less acute in cold weather than in warm. However, the fact that mail cars must be heated in winter, and that this is accomplished by superheated steam pipes located along the outer walls of the car and behind the mail sacks, tends to make the problem of butter shipment in winter somewhat similar to that in warm weather.

The regulations of the Post Office Department on this subject are of such a nature that it is possible to obviate the trouble to a considerable extent in cold weather by marking butter parcels as follows: "Perishable—Keep away from heating apparatus." Mail clerks are expected to be guided by such instructions and to give perishables special care.

With the growth of the parcel post as a method of shipping perishables it would seem not unlikely that in the future some method of refrigeration on a small scale might be developed. Over ordinary distances and under average conditions butter wrapped as outlined can be shipped without deterioration. It should always be chilled before shipment and chilled again immediately upon receipt by the purchaser. It should be dispatched with attention to the mail schedule so that it will be on the road as short a time as possible, and it is preferable that shipments should be timed to make the greater part of the journey at night, when temperatures are materially lower than during the day.

During the strawberry-shipping season, which is just closing, 28 crates of berries have been handled by the parcel post. Twenty-four of these in 16-quart crates were shipped from the Eastern Shore of Maryland. In order to comply with the post-office requirements the crates were fitted with tight bottoms, which would make leakage difficult though not wholly impossible. Parcels of this character weighing over 20 pounds are very generally handled in a manner similar to express and are not put in bags. Those weighing less than 20 pounds are usually placed in mail sacks and the wrapping in either case must be done accordingly. In only two cases did the individual quart boxes containing the berries show sufficient leakage to stain the bottom of the crate itself, and in only one of these cases was there any evidence of leakage on the outside of the crate. Considering the perishable nature of the product and the distance over the ordinary routes of travel from the Eastern Shore of Maryland to Washington this test certainly indicates promise, as the berries were received in fully as good condition as would have been the case by any other means of transportation, and were of better quality than berries selling at a higher price at the particular time in the Washington market.

The shipment of the strawberries raised another small but practical point in the relation of the parcel post to domestic economy. The housewife usually plans to do her preserving or other operations on definite days, hence it is important that the shipper and the carrier accomplish the delivery as requested in order that the buyer may be satisfied. Berries intended to be preserved on Wednesday can occasion a great deal of inconvenience if they arrive on Thursday, when the servant is having a holiday, or the home-keeper herself has other engagements. There is small doubt but that over reasonable distances and with the fruit of proper shipping texture, strawberries can be carried quite satisfactorily.

As an experiment in the practicability of shipping in the present 32-quart commercial crate, 3 shipments were made with the crates only three-fourths full to keep them within the weight limit, and in a fourth case as an experiment outside of the present weight limits a full 32-quart crate weighing 56 pounds was shipped. These crates were received in fully as good condition as the 16-quart crates.

Small preliminary experiments with both sweet and sour cherries have been made, but not enough shipments have been conducted to warrant any statement of conclusions.

During the late winter and early spring 8 or 10 barrels of lettuce produced in the experiments of the department on the Arlington farm, conducted by the Bureau of Plant Industry, were shipped to various parts of the country in 142 parcels. The varieties used in the experiments were the "Boston head" and "Grand Rapids." The parcels usually contained, depending upon the size of the heads or bunches, from 2 to several dozen heads. The average weight of parcels containing 8 to 10 heads was between 4 and 4½ pounds. The average weight of those containing 6 was about 3 pounds. The parcels were shipped not only in the local zone and to near-by points, but to places as far away as Boston, New York, Toledo, Chicago, Minneapolis, and elsewhere. In spite of the fact that zero weather prevailed during a part of the time when experiments were in progress, the lettuce carried through to destination satisfactorily and with only a small percentage of waste. In the local zone, lettuce from shipments that were kept under observation was perfectly fresh and usable at the end of 7 days. Ordinary corrugated cartons lined with paraffin paper and wrapped with ordinary strong wrapping paper were used for the shipments.

Experiments have also been conducted with parcels containing an assortment of vegetables available at the same time. Such shipments have usually been uniformly successful and present an extension of the hamper system which has been inaugurated to some extent by certain of the express companies. The varying degree of perishableness of different vegetables must be borne in mind in making such shipments.

For the convenience of persons desiring to attempt the establishment of direct marketing contracts and for the information of all persons interested in the cost of shipping by parcel post there is given in Table 5 the rate for the local, first, and second zones of all parcels weighing from 1 to 50 pounds.

TABLE 5.—*Parcel postage rates up to 150 miles.*

Weight in pounds.	Local.	Zones, first and second, up to 150 miles.	Weight in pounds.	Local.	Zones, first and second, up to 150 miles.	Weight in pounds.	Local.	Zones, first and second, up to 150 miles.
1	$0.05	$0.05	18	0.14	$0.22	35	0.22	$0.39
2	.06	.06	19	.14	.23	36	.23	.40
3	.06	.07	20	.15	.24	37	.23	.41
4	.07	.08	21	.15	.25	38	.24	.42
5	.07	.09	22	.16	.26	39	.24	.43
6	.08	.10	23	.16	.27	40	.25	.44
7	.08	.11	24	.17	.28	41	.25	.45
8	.09	.12	25	.17	.29	42	.26	.46
9	.09	.13	26	.18	.30	43	.26	.47
10	.10	.14	27	.18	.31	44	.27	.48
11	.10	.15	28	.19	.32	45	.27	.49
12	.11	.16	29	.19	.33	46	.28	.50
13	.11	.17	30	.20	.34	47	.28	.51
14	.12	.18	31	.20	.35	48	.29	.52
15	.12	.19	32	.21	.36	49	.29	.53
16	.13	.20	33	.21	.37	50	.30	.54
17	.13	.21	34	.22	.38			

It should be explained that the local zone rates apply to all business originating within the territory of any office, whether it is received on a rural route or from the city branches of the particular post office.

For distances greater than 150 miles a weight limit of 20 pounds applies. Rates for greater distances are not given, as it is believed that the greater proportion of parcel-post patrons will be developed within the 150-mile radius. A parcel for shipment by mail must not exceed 72 inches in length and girth combined. Determine the length between ends and take the girth at the thickest point. If the aggregate of the two is not greater than 72 inches, the parcel will be received for mailing. The name and address of the sender preceded by the word "From" must be placed on every package. From all money-order post offices to offices of the same class parcels may be shipped "Collect on delivery" on the payment of a 10-cent fee, but the value of the package may not exceed $100.

In Circular No. 3, dated April, 1914, the Division of Classification, Office of the Third Assistant Postmaster General, published a very clear and comprehensive statement of the conditions under which parcel-post shipments may be made, including instructions for preparation and wrapping. This can be obtained by application to the local post office or to the Post Office Department, Washington, D. C., and should be in the possession of every parcel-post patron.

There are many conditions and circumstances under which the use of the parcel post for marketing will not prove economical. There are many others, especially for particular products and under particular conditions, for which parcel-post transportation would seem the only reasonable and economical method. It is not expected that parcel-post marketing will supplant usual methods, but its proper use should certainly make it a valuable supplement to these under all conditions and a check upon other methods when they are not being applied with fairness to either producer or consumer or both.

The first Argentine corn to reach Montreal, Canada, this season arrived on June 20 and consisted of about 200,000 bushels. Some of this is reported to be for local consumption in Canada and some for shipment to the New England States. The ocean rate on corn from Buenos Aires to Montreal at this time was reported at 8.7 cents per bushel of 56 pounds (14s. 6d. per ton). The cargo in question was loaded part at Rosario and part at San Nicolas, Argentine river ports located above Buenos Aires.

The sugar made in Porto Rico from the cane crop of 1913 was reported by the Treasury Department of that island as 398,004 tons (of 2,000 pounds). The production in 1912 was 371,076 tons.

Wheat imported into the United Kingdom during the 5 months ending May 31, 1914, amounted to nearly 68,000,000 bushels. Of this quantity over 20,000,000 bushels came from the United States, about 12,000,000 each from Canada and Australia, about 9,000,000 each from Russia and Argentina, nearly 2,000,000 bushels from British East Indies, and the balance from other countries.

CAR SUPPLY IN RELATION TO MARKETING THE WHEAT CROP OF 1914.

By G. C. WHITE, *Transportation Specialist, Office of Markets.*

Since the publication in the AGRICULTURAL OUTLOOK of May 22 of the forecast of the yield of wheat in the United States for 1914, the question of car supply to move the crop has been engaging the attention of the railroads and grain men. Trade journals have called attention to a prospective car shortage, and railway periodicals have pointed out the necessity of having all box cars thoroughly overhauled and put in condition to handle bulk grain.

The Office of Markets of the United States Department of Agriculture has undertaken some investigations to ascertain to what extent a car shortage this year is anticipated by the grain trade, on what roads shortages are most acutely felt, to what extent the trade keeps in touch with the roads, advising prospective needs, what information is given out by the roads as to ability to fill all orders promptly or steps taken to minimize shortages, and whether or not the car supply keeps pace from year to year with the increasing need for cars. Replies received cover the States of Texas, Oklahoma, Kansas, Missouri, Nebraska, Iowa, and Illinois. These seven States have for 1914 an estimated wheat yield of 385,000,000 bushels.

The sentiment is by no means universal among the country elevators that there will be a car shortage. The belief that there will be a shortage is most prevalent among the country elevators of Kansas. Expressions from terminal elevator points indicate that there will be a shortage in all States.

Opinions as to the roads on which car shortages are most acutely felt amount to little and are apparently based on the particular road on which a man's elevator is located. One man answers that a certain road is most prompt in furnishing cars and another man names the same road as least prompt. Attention is called to the fact that adequate car supply is sometimes due to the volume of inbound merchandise, which, when unloaded, makes available empties for outbound grain shipments. Points served by more than one road testify that they can get cars even when noncompetitive points are suffering from a shortage.

Information from the country elevators is, for the most part, that their advice to the roads of cars needed is in the form of orders for cars at the time they are wanted. Terminal elevators and large grain dealers, however, have kept in closer touch with the situation and have advised the carriers as far in advance as possible of the prospective needs.

On the part of the roads statements from officials through the press are given to the public, and growers and elevator men are personally advised by local agents, traveling freight agents, and other representatives of all steps taken to minimize shortages. Every purchase of new cars is advertised and assurance is given that all cars are being put in condition to handle bulk grain. In some cases large numbers of stock cars are being temporarily fitted up for handling grain. As far as possible, foreign empties are being held by the grain-carrying roads, and country sidings are being filled with empties for the first rush.

It is the consensus that the increase in car supply does not keep pace from year to year with increasing need for cars.

The average carload of wheat contains 1,250 bushels. On this basis it would require 524,000 cars to move the estimated crop of winter wheat for the entire United States the present year and 308,000 cars to move the crop of the seven States here discussed. However, as noted in the Agricultural Outlook of March 23, 1914, only 58.1 per cent of the wheat produced is shipped out of the county where grown, and on this basis the number of cars required would be 304,444 and 178,948, respectively. On the same basis it would require approximately 432,000 cars to move the entire wheat crop of the United States.

The total number of box cars owned by all the roads in the United States June 30, 1911 (the latest report available), was 990,313. Taking 15 of the principal roads in the seven States covered by our investigations, we find that they had on July 30, 1913, 60,446 miles of road and 223,487 box cars. Their aggregate mileage increase for the two years from June 30, 1911, to June 30, 1913, was 3 per cent, the increase in the number of their box cars, 3 per cent, and the increase in the tonnage capacity of their box cars, 7½ per cent. The figures for individual roads vary from a decrease of 14 per cent in the number of box cars to an increase of 32 per cent, and in tonnage capacity from a decrease of 5 per cent to an increase of 50 per cent. These 15 roads contain approximately 25 per cent of the entire mileage of the United States and own approximately 22 per cent of all the box cars. The seven States in question produce approximately 40 per cent of all the wheat of the United States. What the percentage of increase is over the 1911 crop is hard to determine for the area served by these 15 railroads, but it is safe to say that it has been far greater than the percentage of increase in car supply, inasmuch as the estimated yield of winter wheat for the entire United States for 1914 exceeds the 1911 crop by 52 per cent, and the increase in car supply during 1913–14 has been below normal throughout the country.

These figures are given, not as furnishing an exact formula for determining the number of cars needed to move this year's wheat crop and for estimating the shortage in number of cars, but as indicating some of the factors to be taken into consideration in the problem of car supply and car shortage. Other factors are these: The wheat harvest will extend over 3 months or more from about June 10. Doubtless much wheat will be stored after harvest awaiting better prices. Not all the cars of any road serving the wheat belt are available for wheat traffic. The Santa Fe system, for instance, with extensive mileage in New Mexico, Arizona, and California, must necessarily keep a large part of its cars confined to the business of those States. Account must be taken of general commercial conditions also, and of whether the tonnage of other commodities handled in box cars is above or below normal during the wheat movement. Indications this year are for a heavy crop of corn and oats, the movement of both of which commodities will still further complicate the situation as regards wheat.

Even where the entire mileage of a road is confined to wheat-producing territory, many of its cars are absent on other roads, and it may or may not have on its line a sufficient number of foreign cars to offset the absence of its own.

The terms used by different individuals in estimating shortages are by no means uniform. The majority express it in terms of percentage, which is accurate enough if we understand thereby that for a given period only a certain percentage of the cars ordered are furnished. In the long run every man gets all the cars ordered, and from that point of view there is no shortage. No statement of "car shortage" means anything until we know the time limitation and other conditions on which it is based. In its semimonthly bulletins of car surpluses and shortages the American Railway Association lays down the rule that the figures must represent the differences between "cars ordered" on a given day and "cars available." "Cars available" is defined as any empties of the kind ordered, either en route in trains or on sidings, which can be used to fill the orders of that day, and includes also such loaded cars as will be made empty within 24 hours.

The opinion prevails in some sections that any shortage this year will be due more to lack of motive power and terminal facilities than to lack of cars. One of the greatest drawbacks has always been failure to load and unload promptly and too frequent reconsigning of shipments. The indications are that shippers and carriers are cooperating this year more closely than ever before in their efforts to avert a car shortage in the movement of the wheat crop.

TABLE 6.—*Corn and rye: Acreage, condition, forecast and price of corn, and condition of rye July 1, with comparisons.*

State.	Corn.											Rye.	
	Acreage.		Condition July 1.			Forecast 1914 from condition.	Final estimates.		Price July 1.			Condition July 1.	
	Per cent of 1913.	Preliminary, 1914.	1914	1913	10-year average.		1913	5-year average, 1909-1913.	1914	1913	5-year average.	1914	10-year average.
	P. c.	*Acres.*[1]	*P. c.*	*P. c.*	*P. c.*	*Bushels.*[1]	*Bushels.*[1]	*Bushels.*[1]	*Cts.*	*Cts.*	*Cts.*	*P. c.*	*P. c.*
Maine	99	16	85	83	87	626	608	694	86	74	78	.....	.....
New Hampshire	97	21	87	84	87	840	814	967	82	74	78	.....	.....
Vermont	100	45	89	84	88	1,802	1,665	1,792	82	73	76	98	92
Massachusetts	101	48	87	89	89	1,963	1,944	2,041	97	72	81	96	96
Rhode Island	102	11	90	93	92	416	402	430	112	100	97	.....	.....
Connecticut	100	61	87	89	89	2,707	2,348	2,755	84	77	77	98	96
New York	101	632	86	84	82	19,673	15,020	18,682	81	70	76	92	90
New Jersey	99	272	85	87	88	9,710	10,862	10,157	83	71	79	95	94
Pennsylvania	100	1,463	87	87	87	58,549	57,057	56,524	79	68	76	93	93
Delaware	100	197	83	88	90	5,886	6,206	6,089	80	65	74	91	90
Maryland	99	663	86	88	88	22,237	22,110	22,211	76	63	75	92	91
Virginia	97	1,921	83	91	90	44,644	51,480	46,959	91	82	86	87	90
West Virginia	100	732	81	91	90	19,863	22,692	20,137	92	76	85	90	91
North Carolina	100	2,835	85	89	88	49,881	55,282	47,884	98	90	96	88	90
South Carolina	100	1,975	82	86	85	35,629	38,512	31,564	102	94	99	86	85
Georgia	100	4,066	80	91	88	55,298	63,023	53,482	97	97	98	84	88
Florida	102	688	74	95	87	8,146	10,125	8,628	89	93	96	.....	.....
Ohio	98	3,822	87	89	84	146,306	146,250	154,651	72	61	67	92	87
Indiana	101	4,949	88	88	86	189,448	176,400	186,900	69	59	64	93	88
Illinois	99	10,346	88	83	86	376,015	282,150	366,883	68	58	62	90	89
Michigan	101	1,692	92	85	82	63,822	56,112	54,829	69	62	68	95	88
Wisconsin	103	1,700	90	89	85	62,730	66,825	56,346	64	58	63	95	91
Minnesota	106	2,544	81	91	83	82,426	96,000	76,584	56	50	55	89	88
Iowa	103	10,248	100	89	87	404,796	338,300	352,236	63	52	57	94	92
Missouri	98	7,228	82	85	83	207,444	129,062	200,859	79	63	69	86	88
North Dakota	125	469	84	89	83	12,607	10,800	6,938	66	52	61	93	86
South Dakota	110	2,904	92	93	86	85,494	67,320	60,509	59	51	56	94	84
Nebraska	98	7,458	97	91	85	217,028	114,150	164,878	65	53	57	92	85
Kansas	88	6,442	88	81	82	138,890	23,424	129,700	77	58	64	93	76
Kentucky	100	3,650	81	90	88	96,086	74,825	92,543	88	72	78	90	88
Tennessee	100	3,350	80	88	87	77,720	68,675	80,767	91	76	81	91	87
Alabama	102	3,264	76	87	86	48,372	55,300	49,107	97	88	94	76	87
Mississippi	104	3,276	74	85	84	53,333	63,000	51,108	86	82	90	.....	.....
Louisiana	106	2,014	85	87	82	42,798	41,800	35,131	91	81	82	.....	.....
Texas	98	6,664	80	83	78	138,611	163,200	120,286	89	73	82	84	76
Oklahoma	90	4,275	75	87	83	73,744	52,250	75,412	77	60	69	95	75
Arkansas	99	2,450	68	81	84	40,817	47,025	48,439	90	77	85	88	87
Montana	130	36	93	93	90	1,004	882	533	95	72	104	98	95
Wyoming	125	21	93	95	87	527	493	268	80	50	69	96	89
Colorado	110	462	96	88	86	10,644	6,300	6,409	74	54	72	100	87
New Mexico	105	89	96	87	87	2,478	1,572	1,838	90	82	110	.....	.....
Arizona	104	18	94	92	89	592	476	457	90	104	105	.....	.....
Utah	106	11	96	92	91	359	340	254	90	71	79	100	93
Nevada	100	1	96	88	92	34	34	29	.....	.....	.....	.....	.....
Idaho	140	20	86	93	92	585	448	362	70	81	93	95	95
Washington	106	36	90	97	92	972	952	800	75	84	86	96	95
Oregon	107	22	93	94	91	634	598	542	75	72	95	92	93
California	110	60	97	79	89	2,386	1,815	1,745	94	87	93	99	84
United States	99.3	105,067	85.8	86.9	84.7	2,916,572	2,446,988	2,708,334	75.5	63.2	69.5	92.9	89.5

[1]Thousands (000) omitted.

Table 7.—*Winter and spring wheat: Condition and forecast July 1, with comparisons.*

State.	Winter wheat.						Spring wheat.					
	Condition July 1.		Forecast from condition.		Final estimates.		Condition July 1.		Forecast from condition.		Final estimates.	
	1914	10-year average.	July 1.	June 1.	1913	5-year average 1909–1913.	1914	10-year average.	July 1.	June 1.	1913	5-year average 1909–1913.
	P. c.	*P. c.*	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*P. c.*	*P. c.*	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]
Maine							95	97	76	76	76	77
Vermont							90	92	24	22	24	24
New York	94	86	7,614	7,695	6,860	6,793						
New Jersey	80	91	1,232	1,340	1,408	1,475						
Pennsylvania	87	88	21,915	23,183	21,862	21,290						
Delaware	95	88	1,971	1,929	1,638	1,817						
Maryland	94	87	10,355	9,960	8,113	9,290						
Virginia	90	88	9,815	9,391	10,608	9,171						
West Virginia	92	87	3,170	3,126	3,055	2,952						
North Carolina	93	87	6,592	6,308	7,078	5,936						
South Carolina	83	79	863	846	972	761						
Georgia	90	84	1,638	1,552	1,708	1,382						
Ohio	92	77	38,456	37,848	35,100	29,238						
Indiana	91	80	42,966	42,494	39,775	30,668						
Illinois	87	80	44,374	41,824	41,888	33,640						
Michigan	93	79	16,104	15,931	12,776	14,220						
Wisconsin	93	88	1,778	1,759	1,749	1,591	93	89	1,869	1,795	1,916	1,719
Minnesota	89				810	[2] 810	88	85	62,000	63,772	67,230	59,859
Iowa	91	88	10,897	10,810	10,530	6,272	93	89	5,602	5,408	5,865	5,548
Missouri	89	81	40,835	36,706	39,586	31,048						
North Dakota							94	85	95,871	85,598	78,855	90,231
South Dakota	85				900	[2] 900	92	80	48,176	46,185	33,075	38,768
Nebraska	95	80	68,238	65,349	58,125	45,392	93	80	5,423	5,157	4,200	3,687
Kansas	100	72	151,050	148,029	86,515	73,676	85	63	857	907	468	618
Kentucky	101	83	10,986	10,370	9,860	9,037						
Tennessee	101	85	9,166	8,644	8,400	7,718						
Alabama	91	83	380	365	374	297						
Mississippi	85	85	13	14	14	59						
Texas	80	73	14,282	16,858	13,650	8,863						
Oklahoma	100	70	43,138	41,905	17,500	17,224						
Arkansas	93	84	1,289	1,252	1,313	999						
Montana	92	91	13,276	12,973	12,288	7,636	95	93	10,800	10,596	8,385	5,618
Wyoming	91	86	1,194	1,168	1,000	654	91	91	1,476	1,509	1,250	1,019
Colorado	97	82	5,457	5,133	4,220	3,762	95	86	7,391	7,089	5,460	5,266
New Mexico	102	86	1,041	1,021	651	530	98	86	760	729	570	477
Arizona	91	95	903	923	928	642	90	88				[3] 48
Utah	102	91	5,914	5,698	4,600	3,311	97	94	1,979	2,040	1,820	1,853
Nevada	97	96	445	437	368	317	97	98	812	812	713	568
Idaho	95	94	9,823	10,136	8,494	8,600	95	94	5,686	5,762	5,600	4,483
Washington	95	92	32,632	32,062	32,400	24,609	92	88	21,819	21,280	20,900	22,227
Oregon	96	91	15,227	14,995	12,305	12,955	91	87	3,382	3,398	3,412	3,399
California	95	76	7,946	8,113	4,200	7,047						
United States	94.1	80.2	652,975	638,147	523,561	441,212	92.1	84.4	274,003	262,135	239,819	245,479

[1] Thousands (000) omitted. [2] 1913 only. [3] Four years.

TABLE 8.—*All wheat and oats: Stocks on farms and price of wheat; condition, forecast, and price of oats, July 1, with comparisons.*

State.	All wheat.							Oats.							
	Stock on farms July 1.				Price July 1.			Condition July 1.		Forecast from condition.		Final estimates.		Price July 1.	
	Per cent of 1913 crop.	1914	1913	Five-year average, 1909–1913.	1914	1913	Five-year average.	1914	Ten-year average.	July 1.	June 1.	1913	Five-year average, 1909–1913.	1914	Five-year average.
	P.c.	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*	*Cts.*	*P.c.*	*P.c.*	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*
Me.	7.0	5	5	8	....	....	120	97	95	5,539	5,358	5,600	5,029	60	61
N. H.	....	.....	.....	.....	105	....	....	92	93	425	438	420	430	56	62
Vt.	1.0	.....	0	1	100	102	118	91	94	2,969	3,045	3,081	2,869	58	58
Mass.	....	.....	.....	.....	....	....	....	88	94	297	320	315	284	57	57
R. I.	....	.....	.....	.....	....	....	....	85	92	56	61	52	57	45	60
Conn.	....	.....	.....	.....	....	....	....	87	92	345	329	308	342	52	58
N. Y.	4.8	326	241	365	98	101	107	89	90	38,384	36,898	42,712	39,681	48	54
N. J.	6.0	84	73	84	101	100	109	85	88	1,965	1,913	2,030	1,990	49	55
Pa.	7.0	1,530	1,428	1,282	92	100	106	80	90	30,474	31,546	35,774	34,464	49	54
Del.	3.5	57	68	60	85	97	107	63	85	89	118	122	119	49	50
Md.	5.0	406	449	353	85	93	101	70	87	993	1,160	1,260	1,285	51	54
Va.	5.0	530	464	370	95	105	109	58	86	2,714	3,416	4,192	3,839	55	58
W. Va.	5.8	177	159	147	100	104	111	57	88	1,724	2,450	2,760	2,558	56	60
N. C.	5.2	368	255	237	105	107	118	70	85	3,445	3,671	4,485	3,740	62	66
S. C.	3.5	34	18	34	114	118	122	76	84	7,168	6,925	8,460	7,053	69	69
Ga.	4.0	68	26	31	123	118	126	79	88	7,912	7,186	9,240	7,810	64	68
Fla.	....	.....	.....	.....	....	....	....	72	80	648	603	900	701	65	73
Ohio.	6.5	2,282	439	1,857	85	98	106	73	85	50,642	51,437	54,360	65,129	40	46
Ind.	3.6	1,432	403	1,577	76	92	101	65	80	40,841	47,002	36,380	54,666	38	44
Ill.	2.0	838	265	1,119	72	87	96	68	80	120,748	138,592	104,125	144,625	36	43
Mich.	6.4	818	371	838	86	96	105	92	85	51,571	50,177	45,000	47,021	40	48
Wis.	7.0	257	232	187	85	84	97	95	91	84,854	85,515	83,038	74,644	37	44
Minn.	7.5	5,103	5,497	3,835	78	82	99	91	86	110,656	105,062	112,644	96,426	32	40
Iowa.	5.8	951	1,156	619	77	82	92	92	86	172,318	172,121	168,360	166,676	34	40
Mo.	3.5	1,386	998	1,169	71	85	96	60	75	24,990	27,832	26,500	29,307	43	47
N. Dak.	4.0	3,154	6,616	3,252	78	79	95	94	85	74,083	66,828	57,825	57,063	33	43
S. Dak.	5.0	1,699	3,131	1,819	77	79	94	90	81	49,866	49,288	42,135	37,027	35	42
Nebr.	4.0	2,493	2,808	2,394	70	75	88	93	79	67,341	64,835	59,625	54,828	35	41
Kans.	2.5	2,175	3,322	2,391	70	76	92	86	70	54,801	56,148	34,320	39,612	41	46
Ky.	2.0	197	158	225	78	84	100	66	78	2,846	3,083	3,168	3,422	52	56
Tenn.	2.0	168	226	237	85	94	105	73	84	5,516	5,698	6,300	6,126	50	55
Ala.	2.5	9	11	10	112	114	118	86	86	6,792	6,641	6,662	5,157	63	67
Miss.	4.0	1	3	2	....	85	100	86	84	2,927	2,864	2,800	2,146	61	65
La.	....	.....	.....	.....	....	....	....	87	84	1,066	1,092	990	746	56	62
Tex.	3.5	478	331	149	77	87	99	73	76	28,616	32,487	32,500	22,651	42	49
Okla.	1.0	175	482	346	64	75	90	85	69	32,467	33,422	18,540	18,467	38	46
Ark.	4.0	53	32	35	86	90	101	80	80	5,518	5,657	6,360	4,569	52	59
Mont.	5.2	1,075	1,625	577	75	66	92	97	94	25,191	23,914	21,750	18,878	37	54
Wyo.	6.0	135	164	74	90	87	97	92	92	8,906	8,984	8,360	6,399	50	56
Colo.	3.5	339	494	383	77	72	95	77	88	10,397	12,924	10,675	10,397	48	57
N. Mex.	2.0	24	80	38	110	94	118	97	86	1,880	1,812	1,500	1,415	60	58
Ariz.	1.0	9	18	11	120	112	104	94	92	338	346	301	242	64	74
Utah.	6.5	417	473	326	80	75	91	99	95	4,419	4,464	4,140	3,825	47	59
Nev.	6.0	65	40	37	90	120	120	96	96	518	518	473	376	50	79
Idaho.	6.5	916	728	522	72	72	85	97	96	15,136	15,292	15,112	14,061	35	51
Wash.	2.3	1,226	1,289	1,089	73	79	87	94	94	14,517	14,404	14,250	13,493	40	52
Oreg.	4.0	629	736	528	77	82	91	96	92	13,628	13,417	15,228	12,906	37	52
Cal.	3.5	147	201	267	94	100	102	95	85	8,569	8,930	6,636	6,624	58	59
U. S.	4.2	32,236	35,515	28,891	76.9	81.4	96.2	84.5	83.7	1,197,105	1,216,223	1,121,768	1,131,175	38.8	45.2

[1] Thousands (000) omitted.

TABLE 9.—*Barley and flaxseed: Acreage, condition, forecast, and price July 1, with comparisons.*

State.	Barley.							Flaxseed.							
	Condition July 1.		Forecast from condition.		5-year average, 1909–1913, final estimates.	Price July 1.		Acreage.		Condition July 1.		Forecast 1914 from condition.	5-year average, 1909–1913, final estimates.	Price July 1.	
	1914	10-year average.	July 1.	June 1.		1914	5-year average.	Per cent of 1913.	Preliminary 1914.	1914	10-year average.			1914	5-year average.
	P.c.	*P.c.*	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*	*P.c.*	*Ac.*[1]	*P.c.*	*P.c.*	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*
Maine	92	94	140	142	118	77	90	....	....	....	....	....	....	....	....
New Hampshire	92	90	26	27	25	95	92	....	....	....	....	....	....	....	....
Vermont	90	93	362	376	372	85	87	....	....	....	....	....	....	....	....
New York	88	90	1,947	1,936	2,081	71	80	....	....	....	....	....	....	....	....
Pennsylvania	83	90	166	182	179	70	69	....	....	....	....	....	....	....	....
Maryland	89	91	144	146	121	70	62	....	....	....	....	....	....	....	....
Virginia	83	91	274	297	263	77	74	....	....	....	....	....	....	....	....
Ohio	80	87	982	1,064	664	55	69	....	....	....	....	....	....	....	....
Indiana	85	86	211	220	242	50	68	....	....	....	....	....	....	....	....
Illinois	89	91	1,566	1,620	1,603	53	68	....	....	....	....	....	....	....	....
Michigan	93	86	2,346	2,306	2,216	60	72	....	....	....	....	....	....	....	....
Wisconsin	93	90	20,066	20,045	21,351	51	72	85	8	93	88	112	118	141	160
Minnesota	87	85	35,366	35,718	34,044	42	63	90	315	85	86	2,945	3,315	140	171
Iowa	93	88	10,714	10,322	12,395	50	64	93	26	91	89	279	221	124	172
Missouri	76	85	105	120	140	....	78	80	8	83	83	55	96	....	....
North Dakota	93	85	30,830	28,058	22,700	38	58	85	850	91	86	7,580	8,535	140	172
South Dakota	91	81	22,138	20,975	17,368	43	62	80	340	92	88	3,003	3,842	140	171
Nebraska	93	80	2,837	2,713	1,981	44	57	75	7	75	87	52	24	125	....
Kansas	85	65	5,304	4,802	2,921	53	60	90	45	88	81	336	316	....	156
Kentucky	90	87	79	82	76	72	74	....	....	....	....	....	....	....	....
Tennessee	92	88	52	52	62	70	79	....	....	....	....	....	....	....	....
Texas	85	80	218	221	127	60	77	....	....	....	....	....	....	....	....
Oklahoma	86	69	187	206	156	....	55	....	....	....	84	....	6	....	....
Montana	96	94	2,313	2,281	1,189	49	72	80	320	93	94	3,244	2,988	122	....
Wyoming	96	93	464	453	327	85	76	....	....	....	....	....	....	....	....
Colorado	98	89	3,987	3,836	2,530	56	70	80	8	92	90	59	40	118	....
New Mexico	98	87	137	133	65	91	77	....	....	....	....	....	....	....	....
Arizona	91	93	1,380	1,441	1,294	40	68	....	....	....	....	....	....	....	....
Utah	100	95	1,376	1,331	1,006	55	69	....	....	....	....	....	....	....	....
Nevada	98	96	522	528	467	75	93	....	....	....	....	....	....	....	....
Idaho	98	95	7,887	7,875	5,905	47	65	....	....	....	....	....	....	....	....
Washington	94	93	7,237	7,262	6,522	48	65	....	....	....	....	....	....	....	....
Oregon	92	93	4,153	4,319	3,673	53	72	....	....	....	....	....	....	....	....
California	99	82	45,803	45,341	37,690	56	71	....	....	....	....	....	....	....	....
United States	92.6	84.4	211,319	206,430	181,873	47.5	65.3	84.1	1,927	90.5	86.8	17,665	19,501	136.0	170.8

[1] Thousands (000) omitted.

TABLE 10.—*Tobacco and rice: Acreage, condition, and forecast July 1, with comparisons.*

State.	Tobacco. Acreage. Per cent of 1913.	Tobacco. Acreage. Preliminary, 1914.	Tobacco. Condition July 1. 1914	Tobacco. Condition July 1. 10-year average.	Tobacco. Forecast 1914 from condition.	Tobacco. 5-year average, 1909–1913, final estimates.	Rice. Acreage. Per cent of 1913.	Rice. Acreage. Preliminary, 1914.	Rice. Condition July 1. 1914	Rice. Condition July 1. 10-year average.	Rice. Forecast 1914 from condition.	Rice. 5-year average, 1909–1913, final estimates.
	P.c.	*Acres.*	*P.c.*	*P.c.*	*Lbs.*[1]	*Lbs.*[1]	*P.c.*	*Acres.*	*P.c.*	*P.c.*	*Bu.*	*Bu.*[1]
New Hampshire	100	100	99	93	166	168	...	...	...	...	...	...
Vermont	100	100	95	93	171	164	...	...	...	...	...	...
Massachusetts	108	6,600	89	94	10,502	9,524	...	...	...	...	...	...
Connecticut	110	20,200	94	96	32,659	28,337	...	...	...	...	...	...
New York	106	4,600	95	92	5,681	4,997	...	...	...	...	...	...
Pennsylvania	85	33,100	86	90	43,838	57,351	...	...	...	...	...	...
Maryland	80	20,000	78	87	12,480	18,663	...	...	...	...	...	...
Virginia	80	160,000	58	86	80,736	135,388	...	...	...	...	...	...
West Virginia	72	10,800	62	88	5,759	12,762	...	...	...	...	...	...
North Carolina	90	225,000	60	80	108,000	127,339	60	200	88	84	5,597	14
South Carolina	105	46,000	65	82	27,209	22,027	140	6,900	87	86	168,084	273
Georgia	108	1,900	77	90	1,317	1,328	260	1,300	84	88	33,852	64
Florida	108	4,300	77	91	3,046	2,987	90	400	80	85	9,600	15
Ohio	106	86,800	74	87	63,590	79,986	...	...	...	...	...	...
Indiana	85	13,500	70	84	9,828	18,939	...	...	...	...	...	...
Illinois	75	600	80	86	442	842	...	...	...	...	...	...
Wisconsin	106	45,600	98	92	58,094	47,807	...	...	...	...	...	...
Missouri	80	4,100	76	82	3,428	5,578	...	...	...	...	...	...
Kentucky	105	388,500	64	83	248,640	350,502	...	...	...	...	...	...
Tennessee	86	77,400	58	83	40,408	70,426	...	...	...	...	...	...
Alabama	75	200	65	85	91	153	80	200	85	88	5,610	10
Mississippi	...	...	...	...	...	...	90	1,400	85	86	41,650	57
Louisiana	110	700	91	86	376	218	85	344,700	86	88	10,968,354	11,775
Texas	100	200	90	83	144	156	80	242,400	88	88	8,319,168	9,006
Arkansas	90	700	67	85	361	471	88	92,100	83	87	3,287,049	2,739
California	...	...	...	...	...	...	250	15,200	95	...	779,760	[2] 93
United States	94.6	1,151,000	86.0	84.6	756,961	996,087	85.2	794,800	86.5	88.0	23,618,724	24,016

[1] Thousands (000) omitted.

[2] Four years.

Table 11.—*Potatoes: Acreage, condition, forecast, and price July 1, with comparisons.*

State.	Potatoes.								Sweet potatoes.							
	Acreage.		Condition July 1.		Forecast 1914 from condition.	5-year average, 1909-1913, final estimates.	Price July 1.		Acreage.		Condition July 1.		Forecast 1914 from condition.	5-year average, 1909-1913, final estimates.	Price June 15.	
	Per cent of 1913.	Preliminary, 1914.	1914	10-year average.			1914	5-year average.	Per cent of 1913.	Preliminary, 1914.	1914	10-year average.			1914	5-year average.
	P.c.	*Acres.*[1]	*P.c.*	*P.c.*	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*	*P.c.*	*Acres.*[1]	*P.c.*	*P.c.*	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*
Maine	100	128	92	92	27,085	26,077	65	69	....	......	....	....	......	......	....	....
New Hampshire	100	17	90	92	2,142	2,298	95	78	....	......	....	....	......	......	....	....
Vermont	100	25	90	92	3,150	3,414	68	72	....	......	....	....	......	......	....	....
Massachusetts	100	27	90	90	3,256	2,922	105	91	....	......	....	....	......	......	....	....
Rhode Island	103	5	94	91	658	600	120	93	....	......	....	....	......	......	....	....
Connecticut	102	24	91	92	2,621	2,437	110	91	....	......	....	....	......	......	....	....
New York	102	367	91	91	36,737	36,288	90	69	....	......	....	....	......	......	....	....
New Jersey	98	92	81	91	8,346	8,438	112	97	95	22	81	88	2,726	3,066	....	88
Pennsylvania	101	268	87	91	22,383	22,653	89	83	98	1	88	89	114	117	....	101
Delaware	98	11	72	89	847	946	95	98	93	5	84	90	588	657	70	....
Maryland	101	43	75	90	3,225	3,383	90	81	102	8	87	88	974	999	....	....
Virginia	101	106	58	88	6,148	8,137	95	81	95	31	76	89	2,709	3,771	75	100
West Virginia	100	48	62	91	3,006	3,889	107	93	98	2	78	88	193	210	....	115
North Carolina	100	30	62	87	1,693	2,349	96	88	95	76	77	89	6,437	7,737	92	88
South Carolina	105	10	65	84	656	816	133	118	95	48	73	87	3,819	4,508	92	79
Georgia	100	12	70	87	764	928	110	114	95	79	78	88	6,102	7,111	88	86
Florida	110	13	85	87	1,149	918	129	123	90	19	74	88	1,729	2,278	98	85
Ohio	99	158	76	87	11,888	16,193	115	79	98	1	82	87	101	110	124	134
Indiana	100	75	70	86	5,145	7,222	103	85	100	1	81	86	103	118	110	127
Illinois	99	124	65	84	7,738	9,921	126	95	95	8	69	86	662	841	144	144
Michigan	104	304	91	90	37,099	35,273	67	53	....	......	....	....	......	......	....	....
Wisconsin	103	304	91	90	33,197	31,025	60	52	....	......	....	....	......	......	....	....
Minnesota	101	278	83	88	28,612	25,885	65	58	....	......	....	....	......	......	....	....
Iowa	98	147	91	88	13,377	13,227	120	90	93	2	84	90	198	196	....	181
Missouri	102	87	55	80	4,402	6,034	114	114	93	6	72	84	475	639	100	118
North Dakota	101	61	92	89	6,454	4,797	66	70	....	......	....	....	......	......	....	....
South Dakota	103	62	94	90	5,362	4,217	72	87	....	......	....	....	......	......	....	....
Nebraska	99	117	91	85	9,582	7,231	124	114	....	......	....	....	......	......	....	192
Kansas	98	72	78	78	4,774	4,148	120	135	98	5	88	86	462	437	....	142
Kentucky	102	51	50	87	2,422	4,000	126	98	95	9	77	89	693	•941	100	101
Tennessee	99	38	55	86	1,839	2,691	118	92	94	19	75	88	1,411	1,997	110	109
Alabama	100	18	70	89	1,184	1,245	106	107	90	63	70	87	4,763	6,014	84	88
Mississippi	99	12	72	88	864	801	96	100	89	49	73	86	3,863	4,079	80	86
Louisiana	95	24	82	85	1,673	1,457	85	81	95	57	81	88	4,663	5,077	80	74
Texas	98	44	74	78	2,605	2,691	86	99	103	52	83	83	3,884	2,924	125	115
Oklahoma	99	32	87	78	2,227	1,601	93	114	95	6	84	87	479	[illegible]	....	....
Arkansas	96	24	65	83	1,404	1,919	95	94	90	18	67	87	1,290	[illegible]	110	98
Montana	102	37	94	93	5,565	4,215	62	80	....	......	....	....	......	......	....	....
Wyoming	105	13	90	92	1,755	1,094	100	103	....	......	....	....	......	......	....	....
Colorado	97	78	94	90	9,532	8,161	90	94	....	......	....	....	......	......	....	....
New Mexico	120	11	95	88	993	644	135	115	....	......	....	....	......	......	....	....
Arizona	112	1	94	90	99	97	148	144	....	......	....	....	......	......	....	....
Utah	103	21	92	92	3,574	2,722	54	72	....	......	....	....	......	......	....	....
Nevada	105	12	94	94	1,940	1,369	82	107	....	......	....	....	......	......	....	....
Idaho	100	34	86	91	5,409	5,232	60	80	....	......	....	....	......	......	....	....
Washington	98	59	95	94	9,248	8,636	47	84	....	......	....	....	......	......	....	....
Oregon	98	49	92	94	6,311	6,408	46	90	....	......	....	....	......	......	....	....
California	110	75	95	90	10,474	9,375	76	97	103	6	97	93	978	[illegible]	150	173
United States	101.1	3,708	83.6	88.7	360,614	356,627	81.5	76.2	94.9	593	77.1	87.3	49,474	57,628	92.5	93.2

[1] Thousands (000) omitted.

TABLE 12.—*Condition of products named and price of hay July 1, with comparisons.*

State.	Hay (all). Condition July 1.		Hay (all). Price July 1.		Timothy.		Clover.		Alfalfa.		Millet.		Pasture.		Kafir corn.		Canadian peas.		Cowpeas.	
					Condition July 1.															
	1914	6-year average.	1914	5-year average.	1914	10-year average.	1914	10-year average.	1914	8-year average.	1914	8-year average.	1914	10-year average.	1914	8-year average.	1914	8-year average.	1914	8-year average.
	P.c.	*P.c.*	*Dols.*	*Dols.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*
Me.	90	87	13.40	14.62	90	91	90	90	....	....	90	87	93	94	....	....	92	94	....	....
N. H.	90	83	17.80	17.02	91	88	88	86	79	....	95	83	93	90	....	....	....	....	....	....
Vt.	75	88	15.70	14.38	74	90	74	87	65	....	91	88	83	93	....	....	82	90	....	....
Mass.	81	88	20.50	21.12	84	91	79	90	70	....	85	88	84	91	....	....	84	....	....	....
R. I.	75	89	21.00	23.16	76	91	69	91	....	....	90	88	72	91	....	....	....	....	....	....
Conn.	82	87	20.00	22.58	83	90	74	91	....	....	90	88	87	91	....	....	....	....	....	....
N. Y.	78	80	15.00	15.62	78	83	74	84	90	89	81	83	87	89	....	....	87	90	....	....
N. J.	74	84	20.40	19.48	76	83	70	81	87	90	80	84	79	84	....	....	....	....	83	92
Pa.	80	82	14.50	15.98	80	83	75	81	88	89	83	86	84	87	....	....	94	91	90	88
Del.	72	81	14.20	16.02	65	80	71	79	78	88	....	....	66	83	....	....	....	....	80	91
Md.	70	77	14.00	16.08	69	80	69	76	89	87	....	....	71	83	....	....	....	....	89	88
Va.	48	79	17.30	15.96	45	80	50	80	72	84	65	85	52	89	....	....	65	....	74	86
W. Va.	60	79	17.00	15.98	58	80	63	83	77	87	70	84	62	90	....	....	....	....	75	90
N. C.	68	86	18.00	15.96	65	86	69	86	75	87	80	88	66	89	....	....	68	84	75	87
S. C.	72	85	20.00	19.10	65	86	70	87	75	89	76	84	68	87	....	....	70	84	77	85
Ga.	75	88	17.50	18.48	61	90	68	89	75	88	72	88	72	89	....	....	77	....	80	87
Fla.	78	90	18.20	17.26	....	....	....	....	....	....	....	....	78	88	....	....	....	....	81	88
Ohio	72	79	12.80	14.32	71	79	74	80	89	87	75	85	76	89	....	....	80	90	70	88
Ind.	65	80	13.40	13.32	64	80	63	79	85	86	70	84	70	87	....	....	65	82	76	86
Ill.	58	79	14.60	13.22	58	79	59	82	85	88	71	84	60	86	80	86	....	....	60	85
Mich.	81	81	11.70	13.50	82	81	80	82	89	84	89	86	91	87	....	....	93	87	91	86
Wis.	98	85	10.10	12.14	97	85	97	86	95	87	94	88	102	90	90	83	88	90	90	88
Minn.	96	77	7.00	8.24	95	83	96	82	91	84	93	84	97	88	84	....	91	88	90	89
Iowa	83	81	10.00	9.74	81	81	84	81	85	89	94	86	91	88	93	....	98	87	93	89
Mo.	45	76	15.00	11.20	40	74	45	80	80	86	65	77	50	81	74	80	70	83	70	85
N. Dak.	97	81	6.50	6.62	93	84	94	86	98	86	92	84	97	89	104	....	90	....	....	....
S. Dak.	97	75	6.80	7.14	94	82	93	83	98	85	94	84	98	85	94	....	92	....	91	92
Nebr.	96	80	7.40	8.36	94	83	92	87	97	86	94	82	96	86	92	84	....	....	....	....
Kans.	80	80	9.10	8.08	77	80	74	84	89	84	86	77	80	86	89	81	91	....	89	84
Ky.	62	78	17.00	14.80	60	79	59	81	79	87	65	82	59	87	....	....	....	....	70	86
Tenn.	62	82	17.80	15.14	60	84	60	85	75	87	65	83	56	88	60	....	68	....	71	87
Ala.	69	87	16.00	14.02	75	88	74	89	80	89	73	86	65	90	65	....	72	....	75	87
Miss.	70	86	12.90	12.26	....	....	68	85	70	84	76	83	70	90	....	....	73	....	75	86
La.	85	88	12.10	11.72	....	....	86	88	90	89	91	85	88	91	90	....	75	74	77	86
Tex.	94	81	10.50	10.98	....	....	....	....	91	83	86	77	96	88	95	82	81	84	88	84
Okla.	79	78	8.00	8.04	....	....	85	85	84	84	79	79	76	86	86	85	92	....	85	86
Ark.	68	82	13.00	12.26	64	82	70	84	80	88	63	83	64	90	70	84	70	....	65	86
Mont.	97	93	8.30	10.64	95	93	95	95	95	95	91	91	98	97	....	....	95	95	....	....
Wyo.	96	89	8.00	9.74	97	92	96	90	96	90	91	83	101	94	....	....	98	....	98	....
Colo.	102	87	9.00	10.46	99	92	97	89	102	84	95	87	101	91	97	86	98	92	95	90
N. Mex.	96	89	10.50	11.62	99	86	93	85	96	89	92	84	98	80	96	82	92	82	....	....
Ariz.	90	92	15.20	11.06	....	....	....	....	89	93	91	98	87	82	90	94	....	....	....	....
Utah	92	89	8.80	8.86	95	94	96	94	85	83	....	....	98	93	55	....	95	84	99	83
Nev.	99	95	9.60	11.46	100	97	100	94	98	93	....	....	99	97	....	....	96	....	....	....
Idaho	92	93	7.80	9.02	88	94	95	95	93	92	90	....	96	98	....	....	95	96	95	90
Wash.	95	93	10.40	12.98	94	93	96	95	95	94	93	....	95	95	....	....	94	96	92	94
Oreg.	95	90	8.40	10.42	94	92	95	93	90	92	97	98	97	95	....	....	90	92	85	93
Cal.	94	82	8.50	11.58	100	90	98	92	99	93	....	....	99	87	97	91	96	88	96	91
U. S.	80.8	81.9	12.01	12.59	72.7	82.2	69.7	81.9	93.3	87.5	82.1	81.5	82.1	87.6	90.5	83.9	....	....	....	....

TABLE 13.—*Fruits: Condition July 1, with comparisons.*

State.	Apples. 1914	Apples. 10-year average.	Peaches. 1914	Peaches. 10-year average.	Pears. 1914	Pears. 6-year average.	Grapes. 1914	Grapes. 10-year average.	Blackberries. 1914	Blackberries. 8-year average.	Raspberries. 1914	Raspberries. 8-year average.	Watermelons. 1914	Watermelons. 8-year average.	Cantaloupes. 1914	Cantaloupes. 8-year average.	Strawberries. Production.[1] 1914	Strawberries. Production.[1] 8-year average.
	Condition July 1.																	
	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.
Maine	85	79	....	....	84	81	....	....	90	94	90	90	....	....	....	....	94	91
New Hampshire	80	77	15	72	66	80	86	85	88	94	88	90	....	....	80	....	92	86
Vermont	84	77	....	....	55	78	75	85	90	91	88	90	....	....	....	84	88	88
Massachusetts	80	77	25	65	73	78	87	85	87	91	87	88	82	64	....	85	82	86
Rhode Island	80	76	60	65	80	80	90	86	85	93	81	90	78	....	80	85	66	90
Connecticut	74	77	41	68	70	80	85	83	80	94	85	92	80	82	85	86	77	88
New York	75	71	20	60	55	71	80	83	86	90	85	88	83	82	82	81	88	85
New Jersey	81	64	83	62	78	66	90	85	84	89	84	88	79	81	78	81	69	83
Pennsylvania	73	63	59	54	68	64	89	77	85	88	88	88	81	78	82	80	81	82
Delaware	81	63	72	54	45	51	89	83	75	85	75	82	80	80	76	79	66	78
Maryland	74	61	73	55	67	58	91	80	83	88	84	85	81	79	84	78	70	77
Virginia	65	54	56	50	53	50	84	84	75	90	68	86	70	79	70	80	62	80
West Virginia	73	51	64	49	56	46	86	75	72	86	75	84	72	78	71	79	68	78
North Carolina	75	58	75	56	65	52	88	84	82	91	81	87	75	81	74	80	65	84
South Carolina	68	57	73	61	59	59	85	81	72	88	75	84	75	78	74	77	65	82
Georgia	65	55	77	64	57	54	81	84	72	90	67	89	75	82	74	80	69	83
Florida	....	....	75	69	67	57	....	....	....	....	....	....	74	82	68	76	86	81
Ohio	65	50	52	44	62	53	88	78	75	84	79	83	79	77	82	80	71	74
Indiana	45	52	52	49	50	53	86	83	72	84	74	81	78	79	82	80	65	73
Illinois	42	50	58	45	53	46	83	80	68	80	71	78	74	81	73	81	59	76
Michigan	76	66	50	54	74	64	89	79	90	87	91	86	87	80	86	80	89	80
Wisconsin	62	68	....	65	95	70	93	81	97	86	94	84	92	83	90	83	89	84
Minnesota	55	69	....	....	....	....	88	83	89	83	84	82	86	76	86	76	84	76
Iowa	37	56	65	37	58	41	87	80	84	81	82	78	87	83	89	83	71	76
Missouri	54	50	55	43	55	40	75	76	60	74	62	69	73	74	70	74	59	68
North Dakota	84	....	....	....	....	....	....	....	....	....	85	....	90	75	90	....	91	78
South Dakota	62	70	....	....	....	....	85	77	95	....	90	78	87	78	87	77	77	77
Nebraska	57	58	44	39	60	48	76	76	87	76	84	75	89	76	89	77	69	76
Kansas	56	52	50	43	56	48	70	74	70	72	75	69	81	75	85	74	68	66
Kentucky	62	54	73	50	62	50	84	82	74	86	74	82	72	79	72	79	67	78
Tennessee	50	50	62	50	50	45	76	76	74	90	74	83	71	80	70	80	72	82
Alabama	59	57	54	60	50	53	79	78	73	88	74	83	72	81	71	79	77	86
Mississippi	57	57	55	60	57	55	76	78	75	88	65	84	75	78	71	76	80	86
Louisiana	60	60	45	63	55	64	78	82	81	85	80	84	76	80	75	80	83	87
Texas	68	66	25	59	50	61	70	77	79	78	75	76	76	78	76	77	73	80
Oklahoma	60	65	20	60	30	54	70	77	66	76	68	73	75	78	77	77	77	75
Arkansas	65	60	48	62	54	48	78	78	58	83	58	80	65	78	64	79	71	81
Montana	83	84	....	....	80	75	....	....	89	....	91	86	85	84	84	78	90	86
Wyoming	95	....	....	....	....	....	....	....	....	....	98	....	90	90	94	....	95	87
Colorado	94	70	95	52	86	58	92	76	98	81	97	84	91	80	88	81	97	81
New Mexico	86	64	72	54	78	62	88	74	96	....	96	....	87	84	87	82	95	76
Arizona	78	62	80	65	87	75	86	82	99	....	....	....	91	89	94	88	100	89
Utah	98	76	97	67	92	67	99	84	95	90	98	88	92	84	93	82	96	83
Nevada	87	67	83	53	85	66	100	66	99	....	97	....	95	....	98	....	95	78
Idaho	77	81	63	58	71	76	67	83	87	91	90	93	70	86	68	86	86	90
Washington	86	82	65	70	81	81	91	89	93	94	94	94	82	85	82	86	89	89
Oregon	77	80	71	69	71	76	89	90	92	94	93	94	83	83	85	85	88	88
California	84	79	85	74	82	78	94	93	97	94	93	92	93	87	95	88	95	90
United States	64.2	59.4	56.2	56.6	62.4	61.8	89.9	86.9	77.3	84.2	84.7	84.4	76.3	79.5	80.2	79.4	74.2	79.6

[1] Production compared with a full crop.

TABLE 14.—*Tomatoes, cabbages, onions, beans, lima beans, peanuts, hops: Condition July 1, with comparisons.*

State.	Tomatoes.		Cabbages.		Onions.		Beans (dry).		Lima beans.		Peanuts.		Hops.	
	Condition July 1.													
	1914	8-year average.	1914	8-year average.	1914	8-year average.	1914	8-year average.	1914	7-year average.	1914	8-year average.	1914	8-year average.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Maine	88	89	88	90	85	89	89	91	89	91	.....	.....	.....	.....
New Hampshire	88	86	85	88	85	88	91	89	95	86	.....	.....	.....	.....
Vermont	85	90	87	91	82	90	92	91	75	86	.....	.....	.....	.....
Massachusetts	86	87	86	88	89	87	86	89	88	85	.....	.....	.....	.....
Rhode Island	92	88	88	89	85	88	90	90	90	86	.....	.....	.....	.....
Connecticut	87	89	86	91	84	90	84	91	88	87	.....	.....	.....	.....
New York	92	87	88	88	87	88	91	89	88	87	.....	.....	87	84
New Jersey	85	89	81	90	82	90	80	88	85	85	.....	.....	.....	.....
Pennsylvania	84	85	86	88	87	91	82	88	85	87	.....	.....	.....	.....
Delaware	70	86	73	90	80	91	75	.....	80	84	.....	.....	.....	.....
Maryland	74	85	81	87	85	89	84	82	83	81	.....	.....	.....	.....
Virginia	64	88	60	89	71	92	54	85	65	85	83	83	.....	.....
West Virginia	76	89	76	90	80	91	73	86	76	86	.....	.....	.....	.....
North Carolina	73	89	64	89	74	92	65	86	68	88	82	86	.....	.....
South Carolina	70	86	65	86	71	88	65	85	70	84	75	85	.....	.....
Georgia	70	89	60	88	72	90	66	85	65	88	80	88	.....	.....
Florida	77	82	82	87	.....	.....	.....	.....	.....	.....	84	90	.....	.....
Ohio	82	87	82	89	85	90	80	88	81	89	.....	.....	.....	.....
Indiana	77	86	73	87	81	88	80	86	76	84	.....	.....	.....	.....
Illinois	72	87	67	86	76	88	74	86	74	85	.....	.....	.....	.....
Michigan	88	85	89	86	88	86	89	90	86	87	.....	.....	.....	.....
Wisconsin	92	87	93	87	94	89	90	90	90	88	.....	.....	.....	.....
Minnesota	90	83	88	84	90	87	89	88	90	85	.....	.....	.....	.....
Iowa	91	89	86	88	91	91	88	88	86	88	.....	.....	.....	.....
Missouri	67	82	58	81	74	85	68	80	68	81	.....	.....	.....	.....
North Dakota	87	77	88	81	92	86	93	86	92	.....	.....	.....	.....	.....
South Dakota	91	77	90	81	93	84	93	84	33	.....	.....	.....	.....	.....
Nebraska	91	82	87	82	93	85	90	85	88	84	.....	.....	.....	.....
Kansas	84	82	77	79	89	84	90	78	84	80	.....	.....	.....	.....
Kentucky	70	89	64	89	80	91	63	85	66	86	.....	.....	.....	.....
Tennessee	69	88	62	89	76	92	65	86	56	85	70	83	.....	.....
Alabama	69	87	66	87	81	91	64	86	67	87	78	88	.....	.....
Mississippi	71	85	65	83	77	88	73	86	70	86	80	86	.....	.....
Louisiana	80	85	75	83	79	86	83	83	80	86	81	89	.....	.....
Texas	75	78	78	77	80	84	88	80	84	80	77	84	.....	.....
Oklahoma	76	80	68	77	87	84	80	78	79	76	78	82	.....	.....
Arkansas	62	86	59	82	77	89	58	80	55	80	67	85	.....	.....
Montana	91	79	93	92	93	93	90	.....	97	.....	.....	.....	.....	.....
Wyoming	92	81	92	91	96	92	.....	.....	.....	.....	.....	.....	.....	.....
Colorado	90	82	93	87	94	90	96	86	95	87	.....	.....	.....	.....
New Mexico	91	78	91	82	92	90	94	87	89	.....	.....	.....	.....	.....
Arizona	86	86	87	88	87	91	91	88	.....	.....	95	92	.....	.....
Utah	95	84	96	90	99	93	96	86	97	87	.....	.....	.....	.....
Nevada	88	79	95	88	96	91	.....	.....	.....	.....	.....	.....	.....	.....
Idaho	70	86	91	93	94	94	74	90	71	91	.....	.....	.....	.....
Washington	87	84	90	90	91	91	87	88	94	89	.....	.....	97	91
Oregon	89	86	90	94	94	92	89	90	95	89	.....	.....	95	89
California	93	91	94	91	96	93	96	89	92	91	95	90	86	90
United States	77.0	86.2	81.4	87.2	84.7	88.8	89.5	88.8	77.9	85.7	80.8	86.4	91.4	88.6

TABLE 15.—*Condition of sorghum, sugar beets, sugar cane, broom corn; weight per fleece and price of wool, with comparisons.*

State.	Sorghum.			Sugar beets.		Sugar cane.		Wool.					Broom corn.	
	Acreage, per cent of 1913.	Condition July 1.		Condition July 1.		Condition July 1.		Weight per fleece.			Price June 15.		Condition July 1.	
		1914	8-year average.	1914	8-year average.	1914	10-year average.	1914	1913	10-year average.	1914	3-year average.	1914	8-year average.
	P.c.	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P. c.*	*P.c.*	*Lbs.*	*Lbs.*	*Lbs.*	*Cts.*	*Cts.*	*P.c.*	*P.c.*
Maine								6.1	6.1	6.0	21	20		
New Hampshire								6.1	6.2	6.0	19	19		
Vermont								6.5	6.1	5.6	20	19		
Massachusetts								6.2	6.2	6.1	20			
Rhode Island								4.9	5.1	5.1				
Connecticut								5.5	5.2	5.0				
New York								6.2	6.5	6.3	20	19		
New Jersey								5.5	5.2	5.3		17		
Pennsylvania								5.9	6.1	5.9	21	20		
Delaware								5.4	5.4	5.2				
Maryland								6.0	5.5	5.4	23	21		
Virginia	93	74	85					4.6	4.6	4.5	22	21		
West Virginia	90	73	87					5.1	4.6	4.7	24	21		
North Carolina	95	80	88					3.9	3.9	3.6	21	20		
South Carolina	94	75	86			77	84	3.9	3.7	3.4	17	15		
Georgia	95	79	89			80	88	2.8	2.9	2.8	19	19		
Florida	99	85	86			80	88	3.1	3.1	3.1	19	19		
Ohio	95	84	86	80	85			6.5	6.7	6.4	24	20		
Indiana	95	81	84	78	88			6.4	6.5	6.5	22	20		
Illinois	90	76	83	92	91			7.0	7.5	7.3	20	18	77	83
Michigan	98	77	81	92	87			6.8	6.8	6.8	23	19		
Wisconsin	95	88	87	92	90			7.1	7.3	7.1	21	18		
Minnesota	95	86	83	86	87			7.4	7.2	6.8	18	16		
Iowa	93	94	89	94	90			7.5	7.9	7.2	19	18		
Missouri	97	74	83					6.7	6.3	6.4	20	19	64	78
North Dakota								7.5	7.2	6.7	16	15		
South Dakota	115	80						7.4	7.3	6.9	16	16		
Nebraska	100	96	86	94	88			7.6	7.4	7.0	16	14	100	82
Kansas	100	90	84	89	87			7.0	6.9	7.0		15	90	78
Kentucky	95	73	86					4.7	4.6	4.8	21	20		
Tennessee	95	73	87					4.2	4.2	4.0	19	19	68	83
Alabama	98	76	86			77	88	3.8	3.3	3.1	16	18		
Mississippi	98	77	85			79	88	3.6	3.8	3.5	16	16		
Louisiana	92	81	85			81	89	4.0	3.5	3.6	16	14		
Texas	97	92	83			86	86	6.5	6.3	6.0	15	14	90	80
Oklahoma	95	86	89					5.9	5.6	5.9	16	17	82	80
Arkansas	90	71	87			66	87	4.5	4.2	3.8	16	16		
Montana				93	92			7.8	7.5	7.5	18	18		
Wyoming				97	88			8.0	8.3	7.8	18	15		
Colorado	103	95	88	93	90			5.4	5.3	5.9	16	14	90	85
New Mexico	105	96	88	90	89			5.9	5.7	5.7	16	13	95	
Arizona	80	90	91					6.7	6.8	6.6	15			
Utah	98	98	92	97	92			7.4	7.2	7.3	15	15		
Nevada				90				7.4	7.5	7.3	15	14		
Idaho	105	96		91	94			7.8	7.7	7.6	17	16		
Washington	110	94		92	94			8.0	8.3	8.0	16	14		
Oregon				86	92			8.0	8.2	8.0	17	15		
California				95	92			6.5	5.8	5.6	17	14		
United States	95.4	79.6	85.3	92.6	89.8	80.8	88.6	6.8	6.8	6.7	18.4	16.6	82.7	80.5

TABLE 16.—*Prices paid to producers of agricultural products June 15.*[1]

State.	Hogs.		Beef cattle.		Veal calves.		Sheep.		Eggs.		Milch cows.		Horses.	
	1914	4-year average.	1914	4-year average.	1914	4-year average.	1914	4-year average.	1914	5-year average.	1914	4-year average.	1914	4-year average.
	Dols.	*Dols.*	*Dols.*	*Dols.*	*Dols.*	*Dols.*	*Dols.*	*Dols.*	*Cts.*	*Cts.*	*Dols.*	*Dols.*	*Dols.*	*Dols.*
Maine	7.70	7.38	7.50	7.28	8.10	7.78	5.00	4.88	24	23	56.30	50.80	220	202
New Hampshire	8.40	7.62	7.00	6.02	8.40	7.22	5.00	5.70	24	24	58.00	53.40	175	186
Vermont	7.60	7.00	6.10	4.95	7.50	6.35	3.70	4.12	20	21	53.30	48.10	180	167
Massachusetts	9.00	8.75	6.50	6.00	9.50	8.88	.....	.....	28	28	70.00	56.88	245	197
Rhode Island	9.60	8.50	.....	.....	10.00	8.37	4.70	.....	27	30	76.00	62.22	.....	.....
Connecticut	11.50	8.80	8.00	7.37	10.00	8.83	.....	.....	25	27	72.00	53.75	195	206
New York	7.80	7.30	6.00	5.38	8.80	7.65	4.50	4.18	22	22	66.00	54.58	175	182
New Jersey	8.00	8.62	6.70	6.06	10.00	8.45	.....	.....	26	25	71.50	57.52	182	194
Pennsylvania	8.00	7.80	7.20	6.52	8.70	7.62	5.00	4.88	22	21	64.70	50.15	176	178
Delaware	8.70	8.73	6.00	5.80	10.00	9.00	5.60	5.23	21	20	56.60	44.17	145	148
Maryland	7.70	7.45	7.50	5.72	9.60	8.00	4.50	4.85	19	18	56.00	39.30	140	145
Virginia	7.70	7.02	6.30	4.95	8.20	6.80	4.50	4.12	18	17	49.80	38.40	143	144
West Virginia	8.10	7.45	6.70	5.20	8.20	6.73	4.60	4.15	19	18	59.00	41.65	150	144
North Carolina	8.20	7.45	5.20	4.20	6.50	5.22	4.00	4.42	18	16	41.00	33.68	160	152
South Carolina	7.70	7.28	4.60	4.18	5.30	4.98	5.20	5.18	20	18	41.00	36.52	174	179
Georgia	7.80	7.22	4.80	3.92	5.40	4.50	4.20	4.52	18	17	39.50	33.08	157	162
Florida	6.90	6.42	5.30	4.60	6.00	6.25	.....	4.75	21	21	45.40	40.38	145	148
Ohio	7.70	7.38	7.10	5.85	8.40	7.18	4.40	4.02	18	18	63.00	49.12	156	166
Indiana	7.60	7.38	6.80	5.50	7.60	6.70	4.10	4.05	17	17	55.50	46.32	145	155
Illinois	7.50	7.28	7.00	5.78	8.00	6.78	4.40	4.10	16	16	62.50	51.08	145	155
Michigan	7.60	7.28	6.60	5.35	8.00	6.80	4.40	4.50	19	18	60.30	46.35	169	172
Wisconsin	7.50	7.25	5.80	4.68	7.90	6.70	4.50	4.40	17	17	66.50	51.88	170	172
Minnesota	7.30	7.05	6.10	4.78	7.40	6.02	4.70	4.48	16	16	62.10	43.92	156	165
Iowa	7.50	7.28	7.40	5.95	8.30	6.38	4.70	4.70	16	15	62.40	49.95	154	168
Missouri	7.50	7.08	6.80	5.55	7.70	6.32	4.40	4.15	14	14	57.00	47.58	115	132
North Dakota	6.90	6.80	5.90	4.80	7.50	6.25	4.70	4.72	15	15	64.20	47.10	137	158
South Dakota	7.20	7.02	6.60	5.32	7.80	6.05	4.70	4.45	15	16	66.60	45.95	129	148
Nebraska	7.40	7.12	6.90	5.90	8.10	6.68	5.60	5.08	15	14	66.40	49.48	125	137
Kansas	7.50	7.15	6.70	5.82	7.60	6.60	5.20	5.02	15	14	62.00	49.60	117	134
Kentucky	7.30	6.98	6.30	5.08	7.20	6.15	3.80	3.78	15	15	52.50	40.70	125	134
Tennessee	7.20	6.65	5.80	4.35	7.00	5.42	3.90	3.68	15	14	49.30	37.70	140	147
Alabama	7.00	6.65	4.60	3.28	5.20	4.15	4.10	3.65	16	15	38.80	31.05	137	138
Mississippi	6.50	6.48	4.60	3.60	5.90	4.32	4.00	3.98	16	16	40.50	30.50	119	119
Louisiana	6.50	5.80	5.50	4.12	6.00	5.02	5.50	4.98	18	16	40.00	32.35	90	92
Texas	7.10	6.55	5.60	4.42	6.40	5.30	5.00	4.38	15	13	55.50	43.45	91	96
Oklahoma	7.10	6.92	5.70	4.78	6.90	5.95	4.60	4.42	14	14	56.20	43.72	97	110
Arkansas	6.40	5.92	4.80	3.70	5.90	5.35	3.90	3.55	16	14	44.00	32.20	102	114
Montana	7.80	7.82	6.80	6.12	9.00	7.85	5.10	5.78	22	25	81.00	57.20	138	140
Wyoming	8.00	7.50	7.40	5.38	10.50	7.10	5.70	5.33	23	21	75.00	57.95	100	118
Colorado	7.70	7.30	7.00	5.95	9.30	8.12	4.50	5.05	21	21	70.00	55.52	102	126
New Mexico	7.60	7.35	7.50	5.50	9.00	7.00	4.50	4.90	24	23	63.50	56.48	72	87
Arizona	7.90	8.05	6.10	5.38	7.90	6.67	3.90	4.17	31	29	97.00	61.65	117	112
Utah	7.00	7.88	6.00	5.48	9.00	8.30	5.00	5.00	20	19	70.00	47.48	130	122
Nevada	8.30	7.90	6.50	5.93	7.00	7.07	5.00	4.92	30	30	75.00	62.50	150	115
Idaho	7.10	7.12	6.00	5.15	8.00	7.40	4.40	4.78	19	22	78.00	54.12	130	141
Washington	7.20	7.65	6.60	5.68	7.70	7.70	5.10	4.75	22	23	77.00	62.08	140	150
Oregon	7.10	7.65	6.70	5.68	7.90	7.38	4.70	4.68	23	22	74.30	53.52	82	128
California	8.00	7.18	6.60	5.88	7.80	6.72	4.80	4.92	24	23	74.70	55.32	125	158
United States	7.43	7.10	6.32	5.22	7.69	6.54	4.70	4.76	17.6	16.9	59.82	47.09	136.40	146.54

[1] Hogs, cattle, calves, and sheep, dollars per 100 pounds; horses and cows, dollars per head; eggs, cents per dozen.

TABLE 17.—*Averages for the United States of prices paid to producers of farm products.*

Products.	June 15—					July 15—		May 15—		
	1914	1913	1912	1911	1910	1913	1912	1914	1913	1912
Hogs.........per 100 pounds..	$7.43	$7.61	$6.65	$5.66	$8.46	$7.81	$6.64	$7.60	$7.45	$6.79
Beef cattle..............do....	6.32	6.02	5.23	4.43	5.20	5.98	5.44	6.33	6.01	5.36
Veal calves..............do....	7.69	7.53	6.33	5.72	6.57	7.46	6.33	7.59	7.17	6.23
Sheep....................do....	4.70	4.84	4.52	4.24	5.44	4.20	4.21	4.87	4.91	4.74
Lambs....................do....	6.47	6.36	6.02	5.51	7.13	6.05	5.73	6.49	6.66	6.16
Milch cows..........per head..	59.82	55.20	45.84	43.86	43.46	54.80	45.41	59.85	54.80	45.63
Horses...................do....	136.00	146.00	145.00	145.00	151.00	143.00	142.00	139.00	145.00	144.00
Honey, comb. ....per pound..	.138	.139	.140	.133	.132	.139	.139	.137	.138	.137
Wool, unwashed........do....	.184	.156	.187	.155	.195	.159	.189	.172	.163	.178
Maple sugar.............do....	.122	.121	.116	....	....	....	.117	.123	.123	.116
Maple sirup.......per gallon..	1.12	1.09	1.05	....	....	....	1.04	1.10	1.08	1.09
Apples............per bushel..	1.36	1.01	1.08	1.35	1.12	.86	.82	1.46	.94	1.29
Peanuts...........per pound..	.051	.050	.052	.052	.054	.051	.049	.051	.047	.049
Beans.............per bushel..	2.23	2.23	2.62	2.19	2.29	2.22	2.47	2.31	2.18	2.52
Sweet potatoes..........do....	.92	.91	1.11	.94	.77	.89	1.13	.93	.93	1.19
Cabbage......per 100 pounds..	2.61	2.18	2.67	2.46	2.19	2.64	2.29	2.05	1.58	2.98
Onions............per bushel..	1.41	.96	1.55	1.34	1.06	1.02	1.14	1.53	.87	1.77
Clover seed..............do....	7.96	9.77	11.69	8.80	7.24	9.78	10.64	7.87	10.74	12.53
Timothy seed...........do....	2.23	1.77	6.68	5.24	....	1.94	5.96	2.38	1.76	7.16
Alfalfa seed.............do....	6.83	8.08	8.47	....	....	8.20	8.32	6.77	8.21	....
Broom corn...........per ton..	88.00	61.00	79.00	69.00	151.00	57.00	85.00	85.00	53.00	83.00
Cotton seed.............do....	23.62	21.54	19.24	23.38	....	21.37	19.04	23.56	21.88	19.21
Hops.............per pound..	....	.141	....	.226	....	.148	.289	.218	.134	.372
Paid by farmers:										
Clover seed...per bushel..	9.86	12.47	13.49	....	....	12.12	12.82	9.77	12.90	....
Timothy seed.......do....	2.98	2.44	7.37	....	....	2.57	6.59	2.97	2.40	....
Alfalfa seed.........do....	8.31	9.73	10.25	....	....	9.41	10.07	8.38	9.75	....
Bran.............per ton..	27.75	24.67	29.35	25.87	25.37	24.65	28.41	28.08	24.59	30.18

TABLE 18.—*Range of prices of agricultural products at market centers.*

Products and markets.	July 1, 1914.	June, 1914.	May, 1914.	June, 1913.	June, 1912.
Wheat per bushel:					
No. 2 red winter, St. Louis..	$0.76½–$0.77½	$0.75½–$0.97	$0.93 –$0.98½	$0.93 –$1.07	$1.06 –$1.19
No. 2 red winter, Chicago....	.79½– .80	$78½– .96¼	.94 – 1.00¾	.93 – 1.08	1.06 – 1.13½
No. 2 red winter, New York[1]	.99 – 1.00	.96½– 1.10	1.04 – 1.11¼	1.08 – 1.12½	1.21½– 1.28½
Corn per bushel:					
No. 2 mixed, St. Louis.......	.68¼– .68½	.68¼– .73½	.69½– .73	.57 – .64	.72½– .79
No. 2, Chicago..............	.68½– .70	.68¼– .73½	.67 – .72½	.58¼– .63	.72½– .76
No. 2, mixed, New York[1]...	....	....	....	....	.78½– .84
Oats per bushel:					
No. 2, St. Louis..............	.37 – .37	.36¾– .40¾	.38½– .41	.37½– .43	.49½– .54¼
No. 2, Chicago..............	.36 – .36½	.37¾– .42	.37 – .42½	.38½– .43¼	.50½– .53¾
Rye per bushel: No. 2, Chicago..	.58 – .58½	.58 – .67	.62 – .67	.60 – .63½	.75 – .90
Baled hay per ton: No. 1 timothy, Chicago...............	14.50 –15.50	14.50 –16.00	15.00 –17.50	13.50 –15.00	17.50 –25.00
Hops per pound: Choice, New York........................	.36 – .38	.36 – .40	.38 – .41	.17 – .19	.37 – .45
Wool per pound:					
Ohio fine unwashed, Boston.	.24 – .25	.22 – .25	.22 – .23	.20 – .21	.21 – .23
Best tub washed, St. Louis..	.32 – .33	.30 – .33	.30 – .31	.29 – .29	.33 – .35
Live hogs per 100 pounds: Bulk of sales, Chicago...............	8.20 – 8.40	7.80 – 8.40	7.80 – 8.67½	8.40 – 8.80	7.25 – 7.70
Butter per pound:					
Creamery, extra, New York..	.27¼– .27½	.26½– .28	.25½– .27	.26½– .28¾	.26 – .27¼
Creamery, extra, Elgin......	.26½– .26½	.26¼– .27½	.23½– .26	.26½– .28	.25 – .25½
Eggs per dozen:					
Average best fresh, New York	.24 – .28	.22½– .28	.22 – .24	.23 – .28	.21 – .27
Average best fresh, St. Louis.	.18 – .18	.14 – .18	.17¼– .18¾	.14¼– .17	.16 – .17
Cheese per pound: Colored,[2] New York........................	.14¼– .14½	.13½– .15	.13 – .13¾	.14 – .14½	.13½– .14

[1] F. o. b. afloat.
[2] September colored—September to April, inclusive; new colored May to July, inclusive; colored August.

TABLE 19.—*The equivalent in yield per acre of 100 per cent condition on Aug. 1 in each State.*

State.	Corn.	Spring wheat.	Oats.	Barley.	Buckwheat.	Potatoes.	Sweet potatoes.	Tobacco.	Flax.	Rice.	Hay.	Cotton.
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Lbs.*	*Bu.*	*Bu.*	*Tons.*	*Lbs.*
Maine	48.0	27.0	40.5	31.0	33.5	235	......	......	......	......	1.25	......
New Hampshire	48.0	......	39.0	28.7	31.0	150	......	1,900	......	......	1.26	......
Vermont	46.0	28.0	41.5	34.0	27.0	150	......	1,900	......	......	1.47	......
Massachusetts	50.0	......	38.0	......	23.0	140	......	1,900	......	......	1.40	......
Rhode Island	42.0	......	34.0	......	......	155	......	......	......	......	1.27	......
Connecticut	51.0	......	37.0	......	21.0	130	......	1,880	......	......	1.35	......
New York	44.0	......	37.0	30.0	25.5	120	......	1,450	......	......	1.45	......
New Jersey	43.0	......	36.0	......	26.0	128	154	......	......	......	1.60	......
Pennsylvania	46.5	......	36.0	29.0	23.5	106	132	1,610	......	......	1.55	......
Delaware	37.0	......	35.5	......	21.5	118	143	......	......	......	1.55	......
Maryland	41.0	......	33.5	32.6	20.5	110	142	880	......	......	1.60	......
Virginia	29.5	......	24.5	30.0	21.5	106	117	900	......	......	1.45	275
West Virginia	35.0	......	28.0	......	25.0	110	126	980	......	......	1.50	......
North Carolina	22.0	......	21.7	......	21.5	95	112	800	......	31.5	1.55	305
South Carolina	22.0	......	25.8	......	......	103	111	910	......	28.5	1.40	285
Georgia	17.5	......	23.7	......	......	93	101	900	......	32.5	1.55	240
Florida	16.0	......	20.0	......	......	110	123	930	......	30.0	1.50	150
Ohio	45.0	......	41.0	32.5	22.0	108	125	1,030	......	......	1.58	......
Indiana	45.0	......	38.5	31.2	20.5	114	127	1,080	......	......	1.55	......
Illinois	43.0	......	41.5	32.5	22.0	107	123	950	......	......	1.50	......
Michigan	41.5	......	38.0	29.5	19.0	122	......	......	......	......	1.50	......
Wisconsin	42.5	20.7	40.5	33.0	18.5	130	......	1,470	15.2	......	1.68	......
Minnesota	40.0	17.8	40.5	30.5	20.0	129	......	......	11.2	......	1.80	......
Iowa	42.5	18.8	38.5	31.0	19.0	120	120	......	12.0	......	1.55	......
Missouri	37.0	......	35.0	28.3	18.0	100	115	1,150	8.7	......	1.40	350
North Dakota	32.0	15.0	36.5	27.5	......	118	......	......	10.5	......	1.50	......
South Dakota	33.0	15.2	35.0	28.0	......	100	......	......	10.0	......	1.60	......
Nebraska	32.0	17.2	35.0	28.0	21.5	100	105	......	9.8	......	1.65	......
Kansas	28.0	16.5	36.2	27.0	17.0	91	115	......	8.9	......	1.60	......
Kentucky	34.0	......	29.0	29.6	......	98	104	1,050	......	......	1.50	......
Tennessee	29.5	......	26.0	29.0	18.5	90	101	940	......	......	1.60	245
Alabama	19.8	......	23.0	......	......	96	109	700	......	33.5	1.60	220
Mississippi	22.3	......	23.5	......	......	105	109	......	......	36.0	1.65	257
Louisiana	25.0	......	26.0	......	......	87	101	590	......	37.0	1.75	230
Texas	27.0	......	41.5	33.0	......	83	98	810	......	39.0	1.50	211
Oklahoma	28.0	......	37.0	32.0	......	88	110	......	12.0	......	1.35	223
Arkansas	25.5	......	29.5	......	......	95	110	800	......	43.0	1.50	239
Montana	33.0	28.0	50.0	37.0	......	170	......	......	11.1	......	1.95	......
Wyoming	27.5	30.0	41.0	35.0	......	155	......	......	......	......	2.40	......
Colorado	24.5	29.0	44.0	40.0	......	135	......	......	8.5	......	2.50	......
New Mexico	30.0	25.0	40.0	36.0	......	105	175	......	......	......	2.60	......
Arizona	35.5	27.5	45.0	41.0	......	115	148	......	......	......	3.50	......
Utah	34.3	30.0	48.0	43.0	......	190	......	......	......	......	2.95	......
Nevada	35.0	31.0	45.0	41.0	......	172	......	......	......	......	3.10	......
Idaho	34.0	29.0	47.5	43.8	......	190	......	......	......	......	3.10	......
Washington	31.0	23.5	53.0	42.5	......	170	......	......	......	......	2.40	......
Oregon	32.0	22.0	40.0	37.5	......	145	......	......	......	......	2.30	......
California	41.0	......	41.0	33.0	......	148	173	......	......	54.0	1.95	......
United States	33.5	17.4	37.9	31.3	23.8	123.5	111.6	1,006	10.6	38.5	1.65	234.1

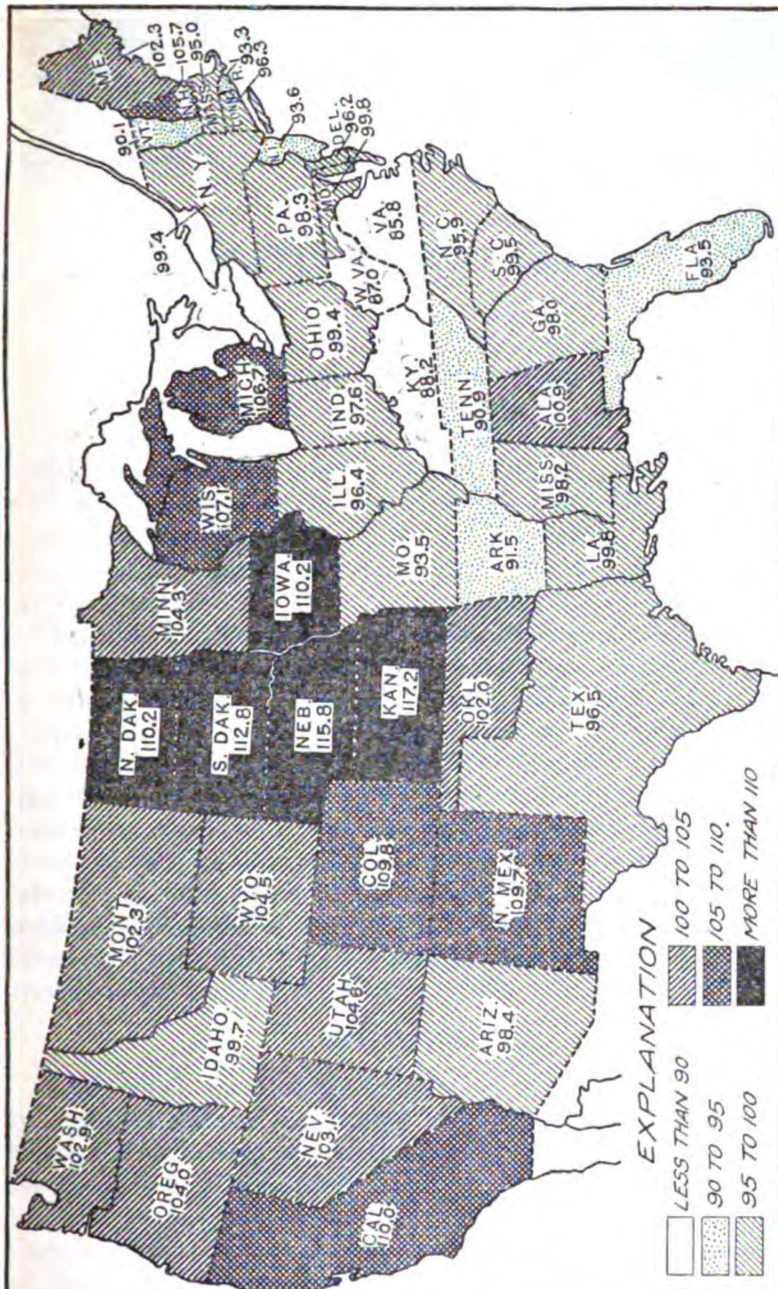

FIG. 2.—Crop conditions July 1, 1914: Composite of all crops (weighted), 100 representing the ten-year average (not normal) condition on July 1.

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FARMERS' BULLETIN

612

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BREEDS OF BEEF CATTLE.

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INTRODUCTION.

The decrease in the number of beef animals in the United States, with the resulting high prices which have prevailed during recent years, has caused greater interest to be taken in this industry, and many men who have never raised beef cattle in the past are taking up this line of work.

The question most frequently asked about cattle usually pertains to the breed which should be used in a certain community or under certain conditions. All breeds are not similar; some have superior points to others, and a certain breed may be better suited to conditions existing in one locality or one State than any other breed. For this reason it is well to find out which breed is best suited to local conditions, and to induce as many farmers as possible to raise that breed, because of the better prices which may be secured from the sale of a uniform product and the ease with which suitable breeding stock may be obtained near home. Some information is presented herewith which will help to answer some of the questions which arise as to the value of the various breeds of cattle.

CLASSIFICATION.

Cattle which are used for the production of beef are divided into two general classes, the strictly beef breeds and the dual-purpose breeds. The former are, as the name implies, valuable mainly for the production of meat, and have been carefully bred and developed in order to produce a maximum amount of beef of high quality. Care has been taken to develop to the greatest extent those portions of the body from which are secured the high-priced cuts of beef. The cows give milk enough for their calves, but not much more.

NOTE.—The distinguishing characteristics of the several breeds of beef and of dual-purpose cattle are presented in this bulletin. The information is of interest to cattle raisers desirous of securing the breed best suited to a particular locality or to certain conditions.

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The dual-purpose breeds are a class of cattle which have been developed to produce a fair to good quality of beef, and at the same time the females should give a good flow of milk.

BEEF BREEDS.

The breeds of beef cattle in the United States are the Shorthorn (sometimes called Durham), Polled Durham, Hereford, Aberdeen-Angus, and Galloway. Each of these breeds has been carefully developed for a long period of years, with the result that individuals transmit their characters very readily when bred to native or scrub cattle. With somewhat frequent exceptions in the case of Shorthorns, the cows of these breeds are not heavy milkers, and in this

FIG. 1.—Champion Shorthorn bull.

point lies their success as beef cattle, for the milking tendency is associated with a conformation of body which prevents the animal from yielding the greatest quantity and the best quality of beef. The beef breeds have been bred for the maximum production of beef, and only enough milk is desired to nourish and produce a good, thrifty calf. They are most popular with farmers or ranchers who raise a considerable number of cattle.

SHORTHORN.

The Shorthorn is the most popular of the beef breeds in the United States, as shown by their numbers and by their general distribution over all parts of the country. They have a great range of adaptability and do well everywhere. The milking qualities, combined with the high standard as a beef animal and the gentle disposition, have caused the Shorthorn cow to be termed "the farmer's cow." The merit of the breed has been proved on the ranges of the West, where the bulls have been used for grading up the scrub cattle of the plains. The Shorthorn crosses well with other breeds or with the scrub cattle, producing from scrub cows calves which develop into fairly desirable beef cattle. The grazing ability of the Shorthorn is not so good as that of some of the other breeds, but where grasses are abundant and feeds are plentiful there is no breed which will surpass it for beef production. The large milk flow insures a good calf. However, the cows have been criticized to a certain extent by western ranch-

FIG. 2.—Prize Shorthorn cow.

men because the large milk flow causes many of them to lose a teat or a portion of the udder, as the calves can not always take all of the milk. The Shorthorn is early maturing, growthy, and fattens readily. The steers sell readily as feeders, and although they have not won as readily as the Aberdeen-Angus in the show ring, they produce very high-class beef, with the thick loin and full hind quarter which furnish profitable cuts.

The three important strains of Shorthorn cattle have been the Booth, the Bates, and the Scotch tribes. The Booth and Scotch strains represent the true beef type of Shorthorns, while the Bates approaches the dual-purpose type. The Shorthorn is the largest breed of beef cattle. The bulls attain a weight of 1,800 to 2,200 pounds or more, while the mature cows usually weigh from 1,300 to 1,600 pounds when raised under favorable conditions. Greater weight in both cows and bulls is not rare, but extremely heavy animals are not especially desired.

The color of this breed may be red, red and white, pure white, or roan. No other breed of cattle has the roan color, therefore this color in any other cattle usually signifies the presence of some Shorthorn blood.

In conformation, the Shorthorn is of the true beef type, being wide, deep, lengthy, and thickly fleshed. The great width of the Shorthorns, combined with their depth, gives them a more rectangular form than any of the other breeds, while the wide variation in the distribution of the breed has caused a slightly greater difference in type to be recognized than in other beef breeds. In the cow the following points should be noted: The horn is usually small and curved forward, with the tips pointing inward, upward, or sometimes downward, and they should be of a waxy, yellowish color. The head should be shapely, with great width between the eyes, short from the eyes to the muzzle, which should be large and flesh-colored, with large nostrils; a black muzzle is objectionable to most breeders. The neck should be short and full, blending well into head and shoulder. The shoulders should be smooth and well covered with flesh, the crops should be full, the heart girth should be large, and the fore flank low. The chest should be wide and deep, with the brisket thick and well to the front. The ribs are usually well sprung and the barrel well developed. In good individuals, the back is broad and the loin is wide, deep, and thickly fleshed. The hips are wide and should be well covered with flesh; the rump is long, wide, and level, carrying an abundance of flesh. The hindquarter is better developed in the Shorthorn than in any other breed; it is characteristic in that it is almost straight from the root of the tail to the hocks, and is wide and thick, carrying the flesh well down, thus giving a maximum amount of flesh. The flank is low, the udder is usually well developed, extending well forward, with prominent milk veins. The teats are of medium size.

The bull should possess the same desirable features as the female, without her feminine qualities. He should show masculinity by developing a heavier horn, a larger and thicker neck, a heavier bone throughout, and greater depth, thickness, and scale. His horns are straighter and heavier than the cow's, but they should not show coarseness.

The Shorthorn has sometimes been criticized because of poor development or lack of fullness in the crops, a high fore flank, and a poorly developed heart girth. They are sometimes rather leggy, although animals of Scotch breeding are usually thick fleshed and low set. There has been a tendency to patchiness near the root of the tail and to rolls on the sides, but the breed is improving in this respect in that the animals are becoming more smooth.

For the benefit of persons desiring information as to the principal lines of breeding in this country, the following has been furnished by the American Shorthorn Breeders' Association:

The ten bulls which have probably done most for the improvement of Shorthorn cattle as a breed in the last 15 years are as follows: Whitehall Sultan 163573, Choice Goods 186802, Cumberland's Last 229822, Avondale 245144, March Knight 188105, Villager 295884, Cumberland 118578, Merry Hampton 132572, Lord Banff 150718, and Whitehall Marshal 209776. The most popular families of Shorthorns in this country at the present time are Augustas, Missies, Victorias, Duchess of Glosters, and Orange Blossoms.

The secretary of the American Shorthorn Breeders' Association is Mr. Frank W. Harding, Union Stock Yards, Chicago, Ill.

POLLED DURHAM.

The Polled Durham is a polled Shorthorn. There are two general divisions of this breed, the "single standard" and the "double standard." The single-standard Polled Durhams were produced by breeding "muley" cows to Shorthorn bulls, selecting the polled offspring and breeding these to other Shorthorn bulls. This grading up was continued until the polled offspring was brought to the fifth cross, which contained 96⅞ per cent or more of Shorthorn blood, and which qualified for entry in the Polled Durham herdbook. The resulting progeny resembled the Shorthorns, but were rather leggy, lacked a thick smooth covering of flesh, and inclined more to the dual-purpose type of animals. These cattle could be registered in the Polled Durham herdbook, but were not eligible for registration in the American Shorthorn herdbook.

The double-standard Polled Durhams were secured by using purebred Shorthorn cows that were either natural muleys or had undeveloped horns, for breeding to Shorthorn bulls. The double-standard Polled Durhams are purebred Shorthorns and can be registered in either the Shorthorn or the Polled Durham herdbooks. The double-standard Polled Durhams were bred chiefly from the Gwynne, White Rose, and Young Phyllis families of Shorthorns.

This breed is similar to the Shorthorn in every way except that it is hornless. It is a comparatively new breed of cattle, and has not become so popular as the older breeds, but it is increasing in popularity. They will do well under the same conditions which favor the production of good Shorthorns. Some breeders have developed the dual-purpose qualities in the animals with the result that there is considerable variation in type.

According to the Polled Durham Breeders' Association, the following bulls have proved to be of great importance in the improvement of the breed in recent years: Golden Gauntlet X 1140, Cambridge Lad 3d X 1300, Golden Hero X 2847, Roan Hero X 3613, Tippecanoe 44th 1698, Field Marshall X 1758, Grover Abbotsburn X 3938, The Confessor X 5985, Windermere Tip X 3094, and Orange King X 3242. The following cows played a most important part in establishing the Polled Durham breed, and their names are found more frequently in pedigrees than any others: Imp. Young Mary by Jupiter, Imp. Rose of Sharon by Belvedere, Imp. Young Phyllis by Fairfax, Imp. Ruby by Young Dimple, and Imp. Rosemary by Flash. At the present time the following cows are of families which

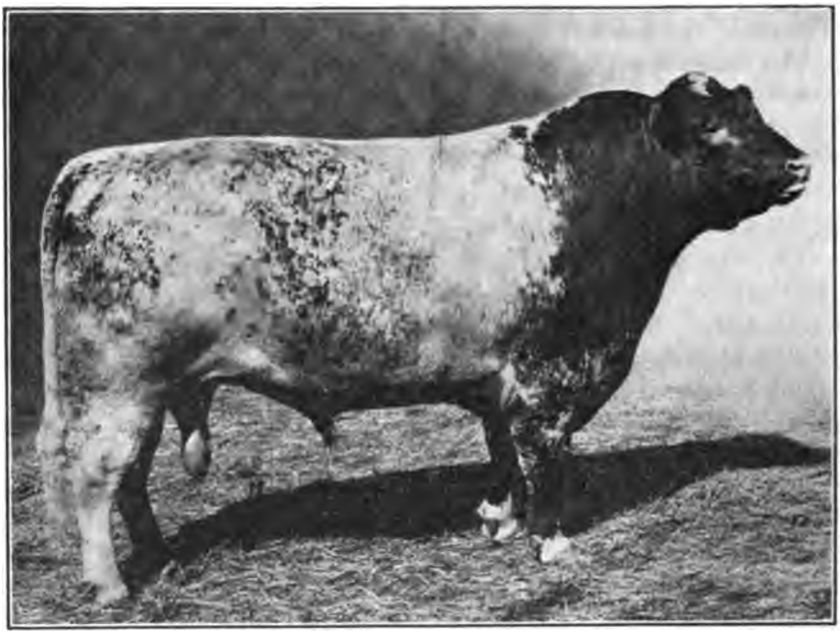

FIG. 3.—Champion Polled Durham bull.

are most prized by the leading breeders: Imp. Victoria 51st by Royal Duke of Gloster (29864), Imp. Windermere 3d by Grand Duke 31st (38374), Imp. Princess Royal 64th by Scottish Archer (59893), Imp. Lady of the Meadow by Chancellor (68693), and Imp. 12th Duchess of Gloster by Champion of England (17526).

The secretary of the Polled Durham Breeders' Association is Mr. J. H. Martz, Greenville, Ohio.

HEREFORD.

The Hereford ranks next to the Shorthorn in numbers in the United States. Their popularity is constantly increasing, especially where cattle are raised under range or adverse conditions. As a "rustler" the Hereford is surpassed by no breed of beef cattle, and they excel the Shorthorns in this respect. They have been recognized as a breed which responds readily to a favorable environment as well as being able to thrive under adverse conditions where other breeds would not do well. On scant pastures and on the range where water holes are far apart the Hereford has shown its merit. The bulls are active, vigorous, prepotent, and very sure breeders.

Formerly the Hereford was severely criticized because of a light hind quarter, but the breed has improved wonderfully in overcoming this defect during the last two decades. The breed is somewhat less rangy, more compact, and heavier fleshed than formerly. While

FIG. 4.—Champion Polled Durham cow.

the Hereford cows have been criticized because of their scanty milk flow, they usually produce enough to raise a good calf. As a breed they have a better heart girth, stronger constitution, and can withstand adverse conditions better than the Shorthorns. They are early maturing and fatten readily in the feed lot.

The weight of Hereford cattle is practically the same as that of the Shorthorn. Mature bulls weigh from 1,800 to 2,200 pounds or more, while good cows weigh from 1,200 to 1,600 pounds. It is not unusual for mature animals of either sex to weigh more than stated here. The conformation of the Hereford is such that he looks smaller than a Shorthorn of equal weight.

In color the Hereford is red with white markings. The white markings usually consist of a white face and head, the white extending along the top of the neck and shoulders, a white throat and dewlap, and white on the underline. Frequently, however, no white is found on the neck or top of shoulders. White is sometimes found on other parts of the body; and, while it is permissible, it is not desirable. A pure-white face is usually preferred, although many purebred animals show spots about the face and especially some red around the eyes. The red color of the body varies from a light red approaching yellow in color to a very dark red approaching black. Neither the light-red nor the blackish-red color is desirable, a rich deep red being the most popular. The hair is usually of medium

FIG. 5.—Champion Hereford bull.

length with a curly tendency, although short-haired animals are common.

The general conformation of the Hereford is the same as that of the Shorthorn, except that the rectangular form is not quite so pronounced and the prominent bones are more smoothly covered. The form is low, compact, and blocky, with well-sprung ribs, broad loin, and wide hips, without the prominent hip bones of the Shorthorn, and with a more rounded and bulging quarter, although developed to a lesser degree in this respect than the Aberdeen-Angus. The head is broad and short with large nostrils, and large muzzle and mouth, which are indications of a good feeder. The horn is longer and somewhat coarser than the Shorthorn, white in color with waxy tips, and curves outward, upward, and backward, or outward and forward, and occasionally they are drooping. The horns of the bull are straighter and heavier, and usually grow outward, frequently growing forward, backward, or downward, but seldom growing upward. The neck is short, thick, and blends well with the shoulder. Great width, depth, and length of chest and a fullness of the crops give the Herefords their constitution and endurance, which the breeders have been careful to preserve. The loin is full and deep and the rump and hind quarter are usually well developed, carrying a large amount of flesh. This portion of the body has been greatly improved within recent years, and the tendency to roughness and patchiness has been reduced until the breed now stands out as one showing extreme beef

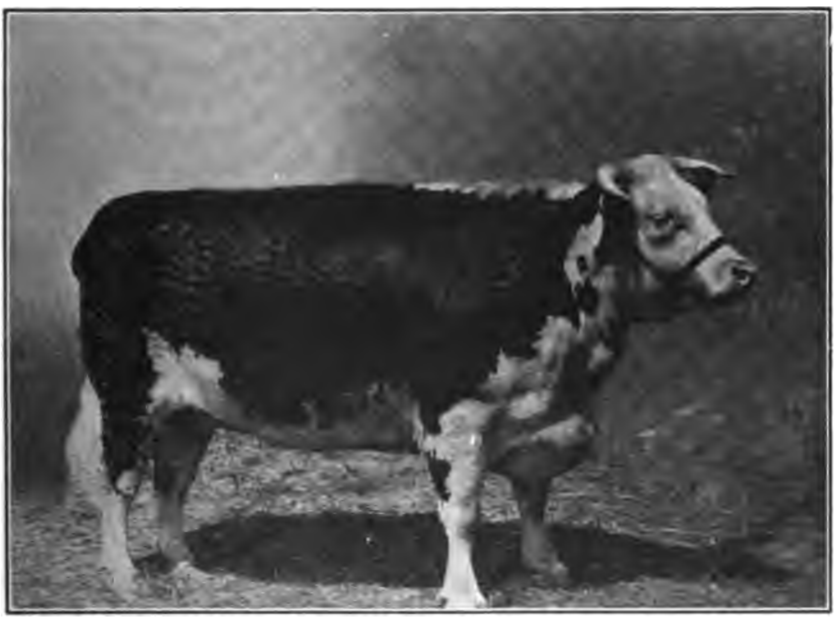

FIG. 6.—Champion Hereford cow.

type, with smoothness of form and much quality. For these reasons, combined with their rustling abilities, the Hereford has become the most popular breed for improving range stock. The effects of using Hereford bulls for this purpose has had a great attraction for cattlemen in the Southwest, especially in the Panhandle region of Texas.

The Herefords do well in the South, as the heat there seems to bother them no more than it does in the corn belt. They seem to be especially adapted for use on the larger plantations, where animals are not given extremely good care, and where the production of beef alone is desired. Two or three crosses on the native stock of the South produce a good beef animal that matures early and fattens out well. On plantations especially or on farms with only fairly good pastures the Hereford will give better results than the Shorthorn.

The American Hereford Cattle Breeders' Association mentions the following as some of the bulls which have been most influential in improving the Hereford breed in the last 15 years: Perfection Fairfax, Beau Donald, Beau Brummel, Corrector, Disturber, Bonnie Brae 8th, Perfection, March On 6th, Prime Lad, and Repeater. At the present time the Anxieties, Perfection Fairfaxes, Beau Donalds, and Belle Donalds are the most popular Hereford families.

Further information concerning this breed of cattle may be secured from Mr. R. J. Kinzer, secretary of the American Hereford Cattle Breeders' Association, 1012 Baltimore Avenue, Kansas City, Mo.

FIG. 7.—Champion Aberdeen-Angus bull.

POLLED HEREFORD.

The Polled Hereford is a new breed developed by selecting and breeding Herefords which showed polled characteristics. The double-standard Polled Herefords are purebred Herefords which are hornless and are eligible to registry in either the American Hereford herdbook or the American Polled Hereford record. They differ in no way from the Hereford except that they have no horns. The polled feature has been well fixed and the bulls when mated with native cattle sire few calves having either long scurs or horns.

The secretary of the American Polled Hereford Cattle Breeders' Association is Mr. B. O. Gammon, Des Moines, Iowa.

ABERDEEN-ANGUS.

Aberdeen-Angus cattle are solid black in color and have no horns. These characteristics are so strongly developed that a bull, when bred to horned cows of various colors, will usually produce calves of which 85 per cent or more are black in color and hornless. Occasionally a red animal is found in this breed, but the color is not popular among breeders. While the Aberdeen-Angus is an old breed, it is only within recent years that it has been so popular in the United States. While they are good rustlers, they have never been as popular on the ranges of the West as either the Hereford or the Shorthorn. They stand next to the Hereford and above the Shorthorn as grazers on scanty pastures. This breed is extremely valuable

FIG. 8.—Champion Aberdeen-Angus cow.

for grading up native cattle, but they have been criticized to a certain extent by rangemen because they do not get a greater percentage of calves. This has usually been true where they have been in a herd with horned bulls. If all the bulls were either polled or dehorned there would doubtless be less ground for this claim. The milking qualities of the cows are only fair; they give more milk than the Hereford, but not as much as the Shorthorn. A sufficient quantity of milk is produced to raise a good calf.

This breed is very early maturing, and has a tendency to fatten well at any age, hence their popularity for producing baby beef. In general form they are different from the Shorthorn and Hereford. The body is more cylindrical in shape, and they are smoother throughout than either of the breeds named. The Angus responds quickly to good treatment, and, because of their readiness to fatten, early maturity, exceptional vigor, high quality, general smoothness and uniformity, and the high percentage of valuable meat produced, it is the most popular of all beef breeds among cattle feeders. They usually dress out a higher percentage of marketable meat than any other breed, and their merit has been shown by the repeated winnings they have made in the show ring and on the block.

They stand either heat or cold well, and are popular in the South as well as in the corn belt. Because of their reputation for finishing smoothly and killing out well they are very popular in the corn belt and neighboring States where much feeding is done. They are becoming more popular in the South, and rank next to the Hereford and above the Shorthorn in their general adaptability to average southern conditions.

The head of the Angus shows a sharp tapered poll, great breadth between the eyes, a prominent forehead, prominent eyes, a nose of medium length, a large mouth and muzzle, and large nostrils. They are more restless or nervous than the Shorthorn. The neck is short, full, and has a well-developed crest in the bull, but it does not always blend smoothly with the shoulders, which are sometimes a little prominent. The chest shows great depth, width, and length. The body is cylindrical in shape and does not show the squareness or blockiness of the Shorthorn and the Hereford, but is noted for its compactness and good covering of flesh. The ribs are well sprung, curved, and long, giving the cylindrical form to the body. The loin and rump are well fleshed and deeply covered, but entirely different in shape from the Shorthorn, as the great width and squareness are absent. The deep covering of flesh of the rump, the smallness of bone, and the deep, rounding, bulging hindquarter gives a maximum amount of meat. Note the difference in the hindquarter of the Angus and the Shorthorn. The latter is broad and straight from pin bones to the hock, while the Aberdeen-Angus has less breadth and a very rounded bulging quarter with a deep twist. The Angus is not so low in the flank as the Shorthorn and some individuals are light in the hindquarter.

The quality of the animal is unsurpassed, as shown by the soft, pliable, mellow skin, and fine hair. The meat is fine-grained and of the highest quality. The constitution and vigor of this breed as indicated by well-developed chest and good heart girth are worthy of mention. For grading up native stock and for crossing, they hold an enviable record.

We are informed by the breeders' association that some of the bulls which have been most prominent in improving the Aberdeen-Angus breed during the last 15 years are Heather Lad of Emerson 2d 19049, Black Monarch of Emerson 30331, Black Woodlawn 42088, Lucy's Prince 46181, Prince Ito 50006, Baden Lad 61883, Blackbird Ito 64116, Star of Denison 82426, Sir Blackbird 98347, Earl Eric of Ballindalloch 100422, and Undulata Blackcap Ito 2d 116275. The leading families in this country at the present time are Blackbirds, Trojan Erica, Pride of Aberdeen, Queen Mother, and Heather Bloom.

The secretary of the American Aberdeen-Angus Breeders' Association is Mr. Charles Gray, Union Stock Yards, Chicago, Ill.

GALLOWAY.

The Galloway is one of the oldest breeds of cattle. They are polled, solid black in color, though occasionally some brown is shown, and have a long, curly, silky coat. This breed is very prepotent and transmits the black color and polled characteristics readily to offspring from cows of any color. As high as 90 per cent of the calves from various-colored cows are black, and from 95 to 99 per cent of the offspring from horned cows are polled. This breed is slow maturing when compared to the Aberdeen-Angus or the Hereford. In size they are smaller than any of the other beef breeds. Mature bulls usually weigh from 1,700 to 1,900 pounds, while the mature cows weigh from 1,000 to 1,300 pounds each.

These cattle are exceedingly good rustlers, not being excelled by any other beef breed in this respect, and their long, silky coat of hair enables them to stand severe weather with little discomfort. For these reasons they have proved to be very valuable on some of the ranges of the Northwest and of Canada. They do not respond so readily to good treatment and to plenty of feed as do the other breeds, and have therefore not become popular in the corn-belt States.

In form they are low set and deep, but are proportionately longer than the Aberdeen-Angus and flatter of rib. The head is somewhat similar to that of the Angus, except that the poll is not as sharp. The head is covered with long wavy hair and the ear is set farther back from the forehead. The body is long and of medium depth. The rump is long and well filled, although the tail head is usually set rather high. The hind quarter is usually good, being full, similar to that of the Angus. The bone is fine, the skin mellow, the hair soft and silky, and the grain of the meat is fine and high in quality. Little attention has been devoted to the milking qualities of Galloway cows, but they give enough milk to raise a good calf. The milk is regarded as ranking high in butterfat and having good quality. The Galloways have commanded especial attention because of their prepotency and the uniformity of the offspring when the bulls are used for grading up or for crossing.

This breed will probably never be very popular in the United States except in the Northwest, where climatic conditions are severe and the range grasses are often scant. In that section, however, the bulls could be used advantageously for grading up native stock.

According to the American Galloway Breeders' Association, the following bulls have played a most important part in the improvement of this breed of cattle during recent years: Worthy 3d 21228 (7762), Scottish Standard 15221 (6488), Druid of Castlemilk 17054 (6159), Captain 4th of Tarbreoch 30933 (9701), Great Scot (6489), Bondsman (7306), Excelsior (7702), The Pathfinder 3d (5991), Keystone (9689), and Sweepstakes (10001). The most popular families, ranking in the order named, are: Maggie, tracing to Maggie of Blackpark (6046); Alice, tracing to Alice of Castlemilk (14282); Nancy Lee, tracing to Nancy Lee of Castlemilk (11971); Lizzie, tracing to Lizzie of Breckonhill (3366); Dora, tracing to Dora of

FIG. 9.—Champion Galloway bull.

Priesthaugh (7008); and Lady Stanley, tracing to Lady Stanley (1670).

Specific information concerning the Galloway cattle can be secured from Mr. R. W. Brown, secretary, American Galloway Breeders' Association, Carrollton, Mo.

DUAL-PURPOSE BREEDS.

The dual-purpose cattle have been bred to produce females which would yield a good quantity of milk and produce offspring which would be desirable for beef. As the type of animal necessary for the production of large yields of milk is entirely different from that of the beef animals, it has been impossible to produce a breed which would combine these functions and be of superior merit for both purposes. The dual-purpose animal may, however, be a desirable milker and at the same time produce calves which make good, though not superior, beef animals. As there has been a constant tendency for some breeders to incline more to the dairy type of animals, while others prefer to develop the beef tendencies, there has been and probably always will be a wide variation in the type of dual-purpose animals. They are not so uniform in conformation as either the strictly beef or dairy breeds. Most breeders prefer to use cows which approach the dairy type nearer than the beef type and to use a bull of the beef type that had a dam with a good milk record. The off-

FIG. 10.—Galloway cow.

spring of such cattle necessarily can not be of as uniform type as the breeds which have but one function to perform.

The dual-purpose cattle are popular with the small farmer who keeps but a few cattle and must depend upon them to produce all the milk and butter needed for the family and at the same time raise calves or steers which will sell readily for slaughter purposes. They have not been popular with the ranchman or farmer who raises large numbers of cattle.

The principal dual-purpose breeds in the United States are certain types of the Shorthorn, together with the Red Polls and Devons. Brahman or "Indian" cattle are sometimes included under this class, and are briefly discussed because of their importance in certain restricted sections of the country.

SHORTHORN.

The dual-purpose Shorthorn is more popular than any of the other dual-purpose breeds. They respond readily to good treatment, and have become exceedingly popular with the small farmer. Formerly these cattle were almost entirely of the Bates strain, but at the present time many of them contain considerable Scotch blood. As a breed they are the same as the beef-bred Shorthorns, except that the beefy tendency is not as strongly emphasized. The milking qualities have been developed, and the cows have a conformation approaching the regular dual-purpose form, being longer of limb, higher in flank, larger in barrel, and thinner in hams than the beef Shorthorns.

FIG. 11.—Shorthorn cow and calf.

The bulls approach the beef type more than the cows, but are lighter in the hind quarter and a little higher in flank and not so heavily fleshed as the strictly beef type. The udder extends high up in the back and well forward, the milk veins are usually very prominent, and the teats are medium to large in size and are well set. Calves from the cows by a well-fleshed bull usually grow and fatten well and make a good quality of beef.

RED POLLS.

The Red Polled cattle originated in England and were introduced into this country in 1873, but few importations were made until about 1885. Since that time many have been imported. This is strictly a dual-purpose breed, and approaches the ideal of the dual-purpose type. In size they are smaller than the beef breeds, and have not the thick covering of flesh. Mature bulls weigh from 1,700 to 2,100 pounds or more and the cows from 1,100 to 1,350 pounds or more. Occasionally very heavy individuals are found, but these are the exception and not the rule.

The cattle of this breed are fair grazers, ranking with or slightly ahead of the Shorthorns, but not equal to the Devon or Hereford. They are very prepotent, and give uniformity in offspring when bred to native cows. Like all dual-purpose breeds, it has been hard to fix or to hold a uniform type, as many breeders incline to beef production, while others try to develop the milking qualities to the detriment of the beef form.

FIG. 12.—Rear view of Shorthorn cow.

This breed has long been celebrated for its early maturity, easy fleshing qualities, and for a fair to good milk flow. The steers have attracted attention and sold for high prices on English markets for years, and have made very creditable showings in this country. They make good daily gains and lay on flesh evenly. They are usually rather leggy, and lack the heavy fleshing qualities of the beef breeds. The hind quarters are less well developed, with a tendency toward a rather thin thigh and a high flank and twist.

The milking qualities of the breed are fair. Many of the cows average over 5,000 pounds of milk a year. The cows flesh up readily when dry. The milk is not rich, usually testing from 3.7 to 4 per cent of fat.

In conformation these cattle resemble the Devon. The head is lean, medium in length, with a well-defined poll covered with a nice tuft of hair of medium length. The neck is longer and thinner than in the beef breeds and does not blend with the shoulders so nicely. The chest is usually well developed and the ribs well sprung, though lacking in a thick covering of flesh. The barrel is developed to a greater extent than with the beef breeds, and the loin and hindquarter are lighter fleshed. The bone is of medium size. The skin is thin, soft, and pliable, and the hair is short and fine, showing quality. The color ranges from light red to dark red, but a deep, rich red is preferred throughout, although a little white on the udder or underline and a white brush are permissible. The udder is well developed in the back, but does not come forward well; it is "chopped off," and the tendency is to develop large teats. The milk veins are prominent and of fair size.

The Red Polls are more nervous than the Shorthorn, but less so than the Aberdeen-Angus. As this is a comparatively young breed, they are not so popular as the older breeds. As dual-purpose cattle

FIG. 13.—Red Polled bull.

they are hard to excel; they are popular in the Mississippi Valley States and have given excellent results for grading up the native cattle in the South, but they have never been used to any extent on the western ranges.

The association for this breed states that the following bulls have probably done more for the improvement of the Red Polled breed during the past 15 years than any others: Corporal 4313, Demon 5421, Abbotsford 4721, Nailer 7396, One Price 8523, Irwin 8253, Cremo 13018, Logan 13500, Dafter 15871, and Elgin 19464. The popular families in this country at the present time are Dorothy, Luna, Pear, Lillette, and Cosy.

The secretary of the Red Polled Cattle Club of America (Inc.) is Mr. H. A. Martin, Gotham, Wis.

DEVON.

This is one of the oldest breeds of cattle. They were introduced into this country at an early date and became popular in New England and in parts of Virginia nearly a century ago. The cows were good milkers, and the steers were used as work oxen or for beef, and filled either place admirably. They are exceedingly good rustlers, are vigorous, hardy, withstand both heat and cold well, and are very prepotent. For these reasons they were popular with the people of New England. They are slower of growth than any of the beef breeds except the Galloway. Their endurance, intelligence, and their

FIG. 14.—Red Polled cow.

gameness have made them popular as work oxen wherever they have been tried—no breed excels them in this respect.

In size they are somewhat smaller than the Red Polled, mature bulls weighing from 1,500 to 2,000 and cows from 1,100 to 1,400 pounds or more. They are solid red in color, white being permitted only on the udder, or near the scrotum of the male, and on the switch of the tail. The shade of red varies, but a rich bright red is preferred. In conformation the Devons incline more to the beef type than to the dual-purpose type. They are close coupled, very compact, smooth, and rank high in quality and style. They have small bone, which is hard and compact, giving a slender, fine leg.

The head is lean, clean-cut, of medium length, and surmounted by rather long white or waxy horns, which curve upward, forward, outward, and backward in the cow and are almost straight in the bull. The horns of the steers are large, long, and often widespread, usually being very white or waxy, with dark tips. The neck is medium in length, smooth, and blends nicely with the shoulder. The body is compact, fairly well covered with flesh, has well-sprung, deep ribs, and is usually low set. The chest, back, loin, and hindquarter are usually well developed, though the flank and twist are

FIG. 15.—First-prize yearling Devon bull.

usually somewhat higher than in the beef breeds. The cows are fair to good milkers, giving rich milk, and always provide an abundance to produce a good calf. The steers fatten somewhat slower than the beef breeds, but produce meat fine in texture and of good quality. The breed can not be surpassed as grazers, but they are usually slower in growth than the beef breeds, and this alone can account for the fact that they have never become popular throughout the country. In New England, in parts of the South, and in a few other States the Devon has proved profitable, especially on lands where the grazing was rather scant or of poor quality. They are prepotent; good calves are produced when good bulls are mated with common cows, and such calves usually make fair milkers. The Devon does not now hold a high rank among the breeds of the United States; since the ox has lost in popularity as a draft animal the Devon has become less popular.

Information concerning Devon cattle may be secured from Mr. L. P. Sisson, secretary of the American Devon Cattle Club, Charlottesville, Va.

BRAHMAN OR "INDIAN" CATTLE.

Under the names of Brahman, "Indian," or Zebu cattle are classified a number of different strains of cattle of the species *Bos indicus*. Some of these strains vary so in type, color, size, and

FIG. 16.—A first-prize Devon cow.

habitat that they are classified as separate breeds. The most important breeds of these cattle are the Krishna Valley and Hissar breeds. These cattle are classed as dual-purpose animals, as many of the females give a good quantity of milk. They are used quite generally in India as milch cows, and are more satisfactory than any other breed of cattle under the severe conditions of drought, heat, insect enemies, etc.

As these cattle have been raised for more than 3,000 years in a hot climate, they are only suitable for the extreme southern portions of this country. Although they are of a different species from our common breeds of cattle, they cross readily with them. The females of this breed carry their calves somewhat longer than other cattle, the period of gestation being about 300 days.

The oil secreted by the sebaceous glands of the skin is of a peculiar odor and gives the skin a soft, oily feeling. This peculiarity, combined with the scant covering of hair and the extremely tough hide, affords these animals considerable protection from ticks, mosquitoes, screw worms, etc. Cattle ticks do not bother the purebred cattle at all, and few of the half-breeds become infested to any appreciable extent.

FIG. 17.—Brahman bull and half-breed heifer.

These cattle stand the heat well and have great endurance, moving readily in a fast walk or trot. They make the best of work steers if handled constantly by one driver, but they have a nervous disposition and give considerable trouble where the drivers are frequently changed. They are more nervous than any of our breeds of cattle. When raised in small herds and handled constantly they are quite docile, but if handled under range conditions they become very wild and stampede or fight readily. The quality of the beef from these animals or from grade Brahmans is slightly inferior to that of either the beef breeds or the dual-purpose cattle, but they dress out a high percentage of meat. For extreme southern Texas and the land adjacent to the Gulf coast in Mississippi, Alabama, Georgia, and Florida, where the ticks, mosquitoes, and screw worms are prevalent, these cattle may prove very valuable for crossing with the native cattle.

FIG. 18.—Purebred Brahman heifer.

In size the bulls range from 1,500 to 1,800 pounds, and many of them attain a height of 6 feet, while the cows usually weigh from 1,100 to 1,400 pounds. The various strains of these cattle have different colors, although each strain has a fixed color. The colors are pure white or a creamy white, silvery gray, red, and dark brown approaching black. The silver gray, with dark fawn on shoulders and neck, and the creamy white are the most popular colors. Many of the animals have brindle stripes on the body.

The chief characteristics of the breed are the large hump on the withers, the large loose folds of skin forming the dewlap and the navel, and the long, drooping, pendulous ears. The head is also characteristic of this breed, as it is long, with a forehead which recedes from the eyes to the horns, while the bones forming the brow are prominent. The head tapers gradually from the eyes to the nostrils, the horns are dark, short, straight, heavy at the base, and point upward and backward. The ears are very long, drooping, and are thin and oily, frequently being almost devoid of hair. The eye is mild and sleepy, but changes quickly when the animal is aroused. The neck is of medium length and has heavy folds of skin forming an overdeveloped dewlap with fullness at the throttle. The body is deep but rather narrow, the hips are long, sloping, and narrow, and the rump often droops toward the tail. The legs are long, tapering, and show a strong bone free from coarseness. A very heavy sheath is developed and in old bulls often hangs 9 inches or more below the belly. The hump is large in the males, attaining a height of 12 to 16 inches, but is not so well developed in the females. The half-bred males may have a moderately developed hump, but the half-bred females have none. Animals which contain as little as one-sixteenth Brahman blood usually show some Brahman characteristics, especially in the shape of the head and the loose folds of skin forming dewlap and navel.

STANDARD BOOKS ON BREEDS AND BREEDING.

The department is frequently asked for information concerning standard books on the subjects of breeds of cattle and cattle breeding. For those desiring such information a list of some of the standard books on these subjects is given herewith. These may be purchased from any of the large publishing houses through a local book store.

Name.	Author.	Price.
Types and Breeds of Farm Animals	Plumb	$2.50
Shorthorn Cattle	Sanders	2.00
Farm Live Stock of Great Britain	Wallace	5.50
Principles of Breeding	Davenport	1.50
Breeding Farm Animals	Marshall	1.50
Judging Live Stock	Craig	1.50

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GOLDENSEAL UNDER CULTIVATION.

By Walter Van Fleet,
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DESCRIPTION OF THE GOLDENSEAL PLANT.

Goldenseal, known botanically as *Hydrastis canadensis*, is a perennial, with a short, yellow rootstock prominently marked with seal-like depressions caused by the falling away of the annual stems. A great many popular names have been given the plant in the past, but goldenseal and hydrastis are now most commonly used.

The stems of goldenseal grow to a foot or more in height and bear two (or rarely three) large, slightly hairy, five-parted leaves. The stems are purplish and hairy above ground, but below the soil surface they are yellow, like the roots.

In early May, before the leaves are fully developed, a single, small, greenish white flower appears on a short branch, or rather on the continuation of the stem above the upper leaf. This flower develops into a berrylike fruiting head, bright red in color when fully ripe and much resembling a large raspberry. Each fruit may contain 10 to 30 black seeds, somewhat smaller than buckwheat grains. Several stems are commonly sent up by the stronger rootstocks, but as a rule only one flower head is developed. In old clumps, as well as on young and weak plants, there are many stems which bear a single leaf but no flower. The stems and leaves usually die down soon after the fruit ripens, but in moist seasons favorable to late growth they may persist until frost. Winter buds, generally two in number, form near the base of each stem. These buds perpetuate the growth next season, but as a rule only one bud starts in the spring, the others acting as a reserve in case of accident.

The fresh rootstock is rarely over 2 inches in length and is about three-fourths of an inch in thickness, giving forth at the sides a profusion of fibrous yellow roots a foot or more in length (fig. 1). It contains a considerable quantity of yellow juice, rather rank in odor, which was formerly used as a dye. When dried, the rootstock

Note.—This bulletin is of interest to residents of Ohio, Indiana, West Virginia, Kentucky, and adjoining States.

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shrinks to about one-fourth of an inch in diameter, becoming hard, knotty, and wrinkled. The dried rootlets are very brittle and break away from the rootstock unless carefully handled. This "fiber," as it is commercially termed, has equal medicinal value with the rootstock, but realizes only about half the price when separated from it.

HABITAT AND RANGE.

Goldenseal is native to open woodlands where there is ample shade, good natural drainage, and an abundance of leaf mold. Its range is from southern New York and Ontario west to Minnesota and south to Georgia and Kentucky, ascending to higher altitudes as its southern limits are approached. The most abundant centers of distribution are in Ohio, Indiana, West Virginia, and Kentucky.

FIG. 1.—Mature root of goldenseal.

In its natural situations goldenseal often grows in dense patches of considerable area, spreading through the loose mold by means of root buds which form irregularly on the long fibrous roots that penetrate the soil in all directions, the growth following chiefly the lines of least resistance, as, for example, along the sides of decayed fallen trees or in the spaces between loose rocks (fig. 2). The rootstocks, too, decay with age and break up into several growing points, which eventually form independent plants.

COMMERCIAL HISTORY.

Goldenseal was commonly used by the Indians and early settlers of eastern North America as a remedy for sore mouth and inflamed eyes, and also as a bitter tonic in stomach and liver troubles, but there was little commercial demand for the root until about 1860. Since that time its use has become world-wide, though by far the greater quantity of the crude drug, both wild and cultivated, is consumed in this country.

Until about the year 1880 the prices paid for crude goldenseal rarely ranged over 8 to 12 cents a pound, these prices, as a matter of course, being based on the actual cost of collecting and curing the material in the localities where it most abounded. In 1890, however, the approaching scarcity of the root was manifested by rising prices, and at the close of the next decade the cost had advanced to an average of 58 cents a pound. Early in 1904 the price passed the dollar mark, the year closing with wholesale quotations varying from $1.35 to $1.50.

It is commonly thought that the wild root is now so near extermination throughout the greater part of its range that it can never again prove an important factor in the market. Natural reproduction is slow, even under the most favorable conditions, and the plants are

FIG. 2.—Goldenseal in forest growth, four years old.

singularly defenseless against the encroachment of the more vigorous vegetation which invades forest lands that are disturbed by clearing and pasturage.

With the exception of slightly retrograde fluctuations in 1912, which were apparently the direct result of overcollection, there has been a steady advance in the price of the dried root, both wild and cultivated. The prices paid to growers and collectors of goldenseal for the last three years have ranged from $3 to $4.25 a pound, and these prices are thought to afford a fair basis of profit in goldenseal culture, even after taking into consideration the rather exacting requirements of the plant and its relatively slow progress toward commercial maturity.

QUANTITY OF ROOT CONSUMED.

Reliable statistics of goldenseal production are not available, but the best-informed drug traders estimate the quantity consumed at 200,000 to 300,000 pounds annually, about one-tenth of which is exported.

Because of its increased cost and probable competition with new remedies, goldenseal may not advance in favor as rapidly in the future as it has in the recent past, but it can be regarded as a natural drug of proved value quite sure to hold its own place.

PRODUCTION OF GOLDENSEAL.

In commerce and in culture goldenseal is closely associated with native ginseng, as both grow in essentially similar locations and have long been collected by the same drug-root hunters. When, therefore, the cultivation of goldenseal began, about 10 years ago, it was naturally taken up by the ginseng growers, who, because of several years' experience in growing ginseng, were well informed concerning the needs of woodland plants. While the cultural requirements of goldenseal are very similar to those of ginseng, goldenseal appears on the whole to be the less difficult plant to grow. The seeds, when properly treated, grow the following season. The roots are rarely injured by mice, which occasion considerable local losses to ginseng growers, and the plant, as a whole, appears to be far less subject to disease. Compared with ordinary garden crops, however, goldenseal is not an easy plant to grow, but requires special care and suitable conditions at all stages of its development.

PREPARATION OF THE SOIL.

The soil in which goldenseal is grown should be well fertilized, and preferably by the use of decaying vegetable matter, such as woods soil and rotting forest leaves, which should be well worked in to a depth of 10 inches or more. Raw bone meal and cottonseed meal are favorable in their action and have also the great advantage of not introducing weed seeds. Both may be applied at the rate of half a pound to each square yard of bed surface, or something over 1 ton to the acre. The best means of supplying the indispensable element, potash, appears to be in the form of the sulphate, using 2 ounces to the square yard, or 600 pounds per acre. Acid phosphate, or dissolved rock, and the various commercial fertilizer mixtures containing it do not appear to suit goldenseal, nor do wood ashes, probably on account of the neutralizing effect of their lime content. These fertilizers—leaf mold, bone meal, cottonseed meal, and sulphate of potash—when possible should be well mixed with the soil two weeks or more before setting the plants. If needed, smaller quantities may be applied subsequently as top-dressings and lightly worked in.

Thoroughly rotted stable manure applied in early spring as a mulch or incorporated into the soil before planting greatly stimulates growth, but sometimes it appears to favor the decay of the crowns and frequently introduces troublesome weeds. For these reasons it is little used by the more experienced growers.

If the soil is of close texture, leaf mold should be used with great liberality, a covering 4 inches deep, with an additional inch or two of sand, being not too much to incorporate when preparing the beds.

For seed-bed purposes sufficient sand and leaf mold should be used to prevent baking after heavy rains, but it is best to omit all other fertilizing material. Seed beds need not be worked deeper than 6 inches, as it is not desirable to have them settle to any great extent.

Plant beds should be formed sufficiently high in the center to shed rain, but it is perhaps not well to make them extremely convex for the purpose of gaining greater planting surface, as the steep slopes dry out too rapidly. Plants may be set 6 to 8 inches apart each way, covering the rootstocks about 2 inches deep. Seedlings and root cuttings may be set 3 inches apart at first and afforded greater space when next transplanted.

PROPAGATION.

Goldenseal is propagated by means of seeds, by division of the rootstocks at the dormant period, and by buds or young plants formed from the stronger fibrous roots. Of the three methods, division of the rootstock is perhaps the one most frequently used, as two or more buds usually form near the scar left by the stem when the top decays after the summer's growth, and it is only necessary to cut apart the rootstock, taking care that a few good roots are secured with each bud or growing point. The portions of the rootstocks with the accompanying rootlets which do not possess buds, or "eyes," may be dried for market. It is the usual practice when digging beds of cultivated goldenseal or when handling the fresh wild root to use for replanting all buds that can be spared from the drying stock. From rootstocks of marketable age an increase of 200 to 300 per cent of propagating material may thus usually be had and a fair surplus of root left for drying. When used for purposes of propagation only, the beds may be dug over each year and the rootstocks divided, thus obtaining under favorable conditions an increase of about 100 per cent.

ROOT-BUD PROPAGATION.

The buds and plants which form on the stronger fibrous roots are very irregularly distributed and occur from 2 inches to a foot from the rootstock. Naturally they are most abundant on the roots of plants which have not been disturbed for several years and which in time form the matted growths that are found in undisturbed wild colonies and in old beds under cultivation. These plants are usually quite small, but may be half an inch or more in height. The larger ones may be planted with the main crop, while the smaller ones are best set under shade, about 3 inches apart. They may be placed in boxes or in beds of prepared light soil with a good proportion of leaf mold, where they may be allowed to grow until large enough to transplant to the regular beds. The plants should be dibbled in, with the growing point an inch or so below the surface. Under ordinary conditions the yield from root buds should add from 50 to 75 per cent of the annual increase. These buds are often quite obscure in form, but practically any healthy thickening on a goldenseal root may be expected to produce a plant if given a fair chance.

PROPAGATION BY SEED.

The earlier goldenseal growers did not greatly favor propagation by seeds, which are rather scarce in nature, owing to the dense growth of many of the wild stands and the frequent destruction of the ripening berries by birds and forest animals. The seeds when gathered were often allowed to dry before they were planted, or they became injured by too rapid fermentation of the fleshy coatings if stratified with a scanty amount of sand or similar inert material. Plantings in forest seed beds appeared to give poor results, owing to various disturbing causes, even when the seeds were in good condition. Under cultivation, however, seeds are freely produced, owing to the better spacing of the plants and their security from birds and animals; and, if properly handled, they should germinate with vigor the following spring, or earlier if sown under glass.

The berries or seed heads should be picked as soon as they begin to show color, and when a sufficient quantity has been obtained it is probably best to knead them in a bag or run them through a fruit squeezer set so as not to crush the seeds, thus getting rid of the fermentable materials in the juice and pulp. The residue, consisting of the skins and seeds, may be mixed with ten times its bulk of sand or sifted woods soil and stratified in well-drained pots or boxes. These should be covered with fine wire netting, to exclude vermin, and kept in a cool, moist cellar or buried in the soil in a shady place free from standing water. The soft parts soon rot away, leaving the seeds in their naturally moist condition, fresh, plump, and bright.

The seeds may be sown in October in a well-prepared seed bed containing a large proportion of sifted woods soil worked in to a depth of 6 inches. They may be scattered broadcast with the stratifying material or sifted out and dropped one-half inch apart in rows about

6 inches apart. The seeds should then be pressed into the moist soil with the flat side or edge of a board and covered with fine leaf mold to the depth of an inch. Burlap or old fertilizer sacks make a very good winter covering for the beds, keeping in the moisture and protecting the seeds from being washed out by the drip from boughs, or from laths if under artificial shade. A mulch of leaves or moss may be placed over the burlap during very frosty weather to lessen the danger of heaving. Seed beds should be especially well protected against the encroachment of moles or mice by means of slates, boards, or wire netting set deep in the ground, and should also be protected against trampling, as the sprouting seeds are readily injured by disturbance.

Should the quantity of seeds gathered at any one time appear too small for pressing, the berries may be partially dried and stratified with a large quantity of nearly dry soil or sand, thus avoiding the intense fermentation that may occur when the fresh fruits are stratified with only a small quantity of inert material. On no account should the seeds be allowed to become entirely dry, as they will then probably fail to germinate, even under the best conditions. For stratifying the seeds, the half-dried berries or seeds should be disposed in alternate layers with sand or mold, the layer of mold being made much the thicker. The receptacles should occasionally be examined to ascertain whether the contents are likely to dry out.

When goldenseal seed is sown in the open, whether under lath shade or in the forest seed bed, the seedlings during the first season rarely get beyond the seed-leaf stage, the true leaves appearing the following spring (fig. 3). If, however, the seeds are planted under glass at the beginning of the year and have night temperatures of about 55° F., with a proportionate rise during the day and adequate shade in the following summer, sufficient progress may be made by the close of the season to develop good-sized leaves, with rootstocks large enough to plant out in the beds.

In the experiments of the Department of Agriculture there have been grown in a single 10-inch pot, in 10 months, as many as 50 vigorous seedlings (fig. 4), with from one to three buds to a single rootstock and with roots more than a foot in length (fig. 5). These seedlings were grown from properly stratified seeds which were collected in August and sown the first week in the following January in a compost of equal parts of leaf mold and loamy garden soil.

Low greenhouses, such as are used for growing ordinary vegetable plants in midwinter and early spring, would afford congenial conditions for goldenseal. Since greenhouses of this type may be built at small cost, it may be questioned whether such glass protection for the seedlings would not be a real economy, considering the saving in time and the gain in vigor of the plants.

When collected in small quantities, the fresh berries may be broken part and at once planted in pots or seed beds, or the seeds may be vashed out and immediately planted, but the results are rarely as

FIG. 3.—Goldenseal plant grown under a lath shed, second year.

ood as when the seeds are stratified. On no account should the erries be planted whole, as the seedlings, if they come up well, will e too crowded for satisfactory development.

SHADE.

When well established in favorable soil goldenseal will endure nearly full sunlight, but for satisfactory growth it requires about 75 per cent of shade in summer, though much less will answer in spring. In other words, three-fourths of the sun's rays should be excluded in summer, either by forest shade or by structures of convenient height covered with laths, cloth, brush, or vines sufficient for the purpose. In northern sections less shade is thought necessary than in southern localities. The shade should be open to the north and also to the east in order to permit the greatest amount of ventilation, but should be covered at the top and on the south and

FIG. 4.—Goldenseal seedlings grown under glass, five months from sowing.

west sides with brush, boards, or laths so spaced as to exclude about three-fourths of the sunlight. Very heavy burlap has been used with fair success for shading woodland plants, but thin or ordinary muslins do not intercept enough light, while they frequently appear to retain heat to an injurious degree. In the North, where open construction is preferred, use can be made of grapevines, Lima beans, or morning-glories, which may be planted on the south and west sides and allowed to run on wire netting, thus furnishing shade during the bright summer months; but the grapes at least should stand at some distance from the arbor, in order that the feeding roots may not interfere with the goldenseal.

There are many methods of obtaining the necessary shade, the most common being to set posts of durable wood firmly in the ground 8 feet apart each way, rising to about 7 feet in height above the soil surface. Scantlings 2 by 4 inches in size are nailed on top of the posts, running the long way of the shed. The shade is usually provided in sections 4 by 8 feet long, using common 4-foot laths or slats nailed on strips 2 by 2 inches and 8 feet long. The laths should be spaced from one-fourth to one-half inch apart, according to the locality, whether in the North or in the South. These sections of the shading structure are laid on top of the 2 by 4 inch runners and are so nailed or tied to the posts that the laths run nearly north and south, thus giving the plants below the benefit of constantly alternating light and shade. When the sections are wired or tied instead of being nailed fast to the runners, they may be taken off and stored during the winter, thus adding greatly to their durability and avoiding damage to the sheds from heavy snowfalls.

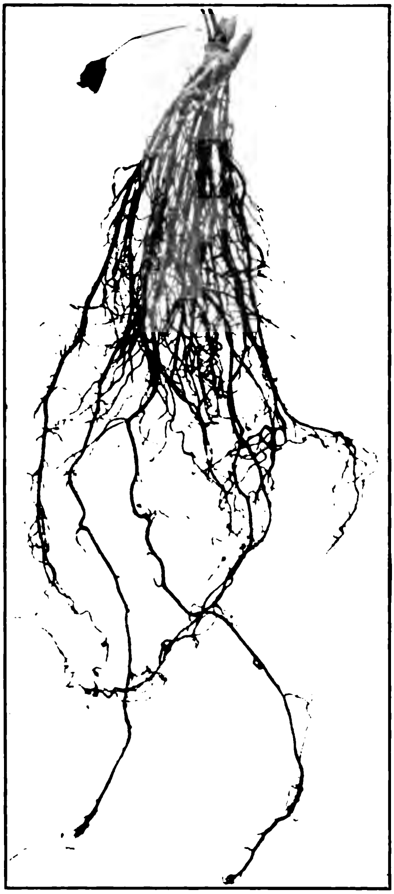

FIG. 5.—Pot-grown root of goldenseal, 10 months old.

For covering the seed beds a rather low shade is desirable, in order to prevent the washing out of the seeds by the drip from the laths. Poultry netting covered with brush, straw, litter, or burlap, made light in spring and denser as the sun gains power, answers the purpose very well.

The beds under shade are made about 4 feet wide and preferably run east and west, being so placed that the drip from the ends of the laths will, to a great extent, fall in the paths. The sides of the beds are usually made of 12-inch boards set at least 8 inches in the ground to keep out moles and held in place by small stakes. The soil should be fairly light and so well drained, naturally or artificially, that water can at no time remain on the surface of the beds. Should artificial drainage seem necessary, one or more lines of small tiles may be placed under each bed, discharging at points low enough to carry away all surplus soil water. The soil should be in good tilth and rich enough to grow at least ordinary vegetables without the addition of strong manures.

VENTILATION.

Forest plantings secure the natural ventilation which is required by the goldenseal plant, and in all artificial shading provision must be made for the free circulation of air, particularly in moist or cloudy weather. Protection from direct sunlight overhead and on the south and west is all that is needed. The northern and eastern aspects of all shading structures should, as a rule, be open, and whenever possible the air movement should be unobstructed by near-by buildings or plantings other than those furnishing the necessary shade. The height of lath houses or other shading appliances, except in the case of seed-bed protection, should be sufficient to allow a good circulation of air and also a convenient working space. Seven feet of clearance above the path levels is sufficient for the purpose. In exposed situations a windbreak of timber, trees, or shrubbery a few feet from the shading structure in the direction of the prevailing windstorms may be of great service in preventing damage to the tender growth without greatly reducing the ventilation requirements.

MULCHING.

Summer mulches of buckwheat hulls or well-rotted hickory, maple, or basswood sawdust are especially favorable for seed beds and young plants, as such materials greatly conserve the soil moisture and prevent much weed growth. Sawdust from pine or oak is not favored. Of more importance, however, is the winter mulch of leaves, bean vines, cowpea hay, or other coarse litter not containing weed seeds or material attractive to mice, as it lessens heaving and the undue frosting of the crowns, and as a protection from the drying winter winds it is quite in accordance with the natural woodland conditions. Winter mulches are particularly necessary for seed beds, 4 or 5 inches of leaves or their equivalent in litter being ample for the severest climates, while less is needed in the South. As a rule, the material need not be placed in position until actual freezing is imminent, and should be removed in the spring before the first shoots come through the soil.

ATTENTION REQUIRED.

Aside from keeping the beds free from weeds and other interfering vegetation at all times during the growing season, goldenseal needs little attention. If loose mulches of fine materials, such as buckwheat hulls or old sawdust, are used, they may be allowed to remain during the summer and will go far toward the suppression of weed growth. If the mulch is thin and the soil shows signs of crusting during dry weather, the earth may be lightly stirred with a suitable tool, but deep culture at any time is likely to do more harm than good by breaking up the mat of fibrous roots that run near the surface.

Goldenseal has a relatively short growing season, and its growth may be seriously checked by untimely droughts. Liberal applications of water at such critical times—applying enough at once to soak the beds thoroughly—may make the difference between partial failure and a successful season's growth. Growers of goldenseal may well consider the advantages of dry-weather irrigation where it appears to be practicable.

FOREST-BED CULTURE.

After passing the seedling stage, goldenseal is well adapted to forest culture, as the plants are not preyed upon by wood mice, which so often work serious havoc with the tuberous roots of ginseng. The location selected should have good drainage, as the plants, though fond of moisture, do not thrive in boggy ground. It should be well shaded by tall trees rather than by undergrowth. Oak, maple, sycamore, and basswood afford very suitable shade; but pine, spruce, hemlock, and similar trees should be avoided.

The plat should be deeply plowed or spaded and all tree roots removed to the depth of a foot or more, the future encroachment of the roots being reduced by cutting around the beds yearly with a sharp spade. In addition to the natural coatings, a liberal dressing of leaf mold or well-decayed litter should be deeply worked into the soil, and it is well also to rake in bone meal and potash sulphate at the rate of 10 and 4 pounds, respectively, to the square rod when finishing off the beds. The plants should be set in the same manner and at the same distances apart as those under artificial shade.

Except that forest beds require more frequent supplies of plant food and water on account of the competition of tree roots, cultural treatment is in all respects similar to lath-shed plantings, even including the winter mulch of fallen leaves when not sufficiently supplied by nature.

DIGGING AND CURING.

The roots may be dug at any time in autumn after the tops have died down. It is best to take up the beds solidly when of sufficient age, as the root buds and small plants are generally abundant enough to reset if it is thought desirable.

The rootstocks and attached rootlets are washed clean of all soil and freed from sticks, pebbles, or other foreign matter lodged in the fibrous masses. All buds and divisions needed for further propagation should be removed before drying. The rootstocks are conveniently dried on lath screens in an airy place in mild sun or partial shade, or indoors on a large, clean, dry floor. They should be turned several times daily until thoroughly dried. When dried in the open they should be protected from dew at night and taken under cover on the approach of rain. In very dull weather it may be well to finish the drying in a heated room with a temperature of about 80° F.

The cured root is best kept in rather loose masses in a dry, airy place secure from vermin until ready for market. If closely packed while at all moist it may be attacked by mold, which greatly lessens its value. Thoroughly dry root may be shipped safely if tightly packed in bags or boxes, or in barrels well lined with paper.

The market is found with the crude-drug dealers and manufacturing druggists in most large cities. Goldenseal root is also handled on commission and is readily purchased by fur buyers and traders in miscellaneous forest products.

DISEASES AND PESTS.

Goldenseal appears naturally to be a healthy plant, and its culture is too recent to have brought to notice any special diseases affecting it. If much exposed to the drip from lath or other shading, the seedlings may be attacked by ordinary "damping-off," and in very humid weather the thick-growing tops of full-sized plants may succumb to mold, such as is often found in damp places on lawns. A free circulation of air and shelter from unnecessary drip are the best preventives of these troubles, although a few growers use Bordeaux mixture to ward off attacks. There is also an occasional collapse of the tops, apparently due to blight.

The growing plants are subject to checks by drought, the tops dying down long before the normal close of the growing season, but without greatly affecting the underground portions. Slugs and earthworms disturb the seedlings, the slugs eating the crowns down to the rootstocks. Moles also may cause loss by upheaving the beds. Irrigation is the rational cure for drought, and cautious applications of lime will reduce the annoyance from worms and slugs, but the best means of controlling the latter is to pick them off by hand at night with the aid of a lantern. The moles may be trapped, or, better, may be kept out entirely by bordering the beds with slates, boards, or fine wire netting set 8 inches or more in the ground.

The roots of goldenseal are little subject to root-gall and the plant can therefore be used as a succession crop for ginseng beds which have become infected with the gall. While goldenseal at present is comparatively free from diseases and serious pests, it is to be expected that the future will bring forth new cultural difficulties of different kinds.

TIME TO PRODUCE A CROP.

Under favorable cultural conditions goldenseal reaches its best development for market in about five years from the germination of the seeds, or a year or two less when grown from root buds or by division of the rootstock. After the fourth year decay of the center or of the older parts of the rootstock may set in, thus offsetting the natural increase in size and weight. This decay of the old rootstocks has its compensation where increase of plants is desired, but from the market standpoint it is objectionable.

Goldenseal is valued solely for its remedial properties, and age depreciates rather than enhances the trade value of the root after reasonable maturity has been reached.

YIELD AND COST.

Goldenseal culture is too new and has thus far been conducted too exclusively for the increase of stock plants rather than directly for the drug product to have afforded much information regarding yield. Experiments conducted by the Office of Drug-Plant Investigations at the farm of the Department of Agriculture near Arlington, Va., on small plats under lath shade have given yields at the rate of about 5,000 pounds of green root to the acre, representing nearly 1,500 pounds of dried root. The conditions at this place, however, are far from ideal for forest-loving plants. Successful growers of goldenseal have outputs of dry root at the rate of 2,000 pounds per acre at five years from seed. Possibly such yields may not be greatly exceeded in large plantings, but well-equipped small growers who can give their crops special attention may make much better showings.

The cost of goldenseal culture is necessarily greatly controlled by special conditions, the chief of which are the local costs of labor, lumber, and fertilizing materials. The outlay for starting a plantation is about $1,500 an acre, exclusive of the value of the land. This includes the average cost for propagating material, but makes no provision for irrigation or watering during dry weather.

The preparation of the forest beds usually represents an outlay approaching $200 per acre, with such additional expenses as may be necessary for protection, fertilization, and irrigation, as the live tree roots are greedy absorbers of plant food and water and always appropriate a considerable share of the fertilizers applied.

Small home and experimental plantings usually may be initiated with very little expenditure of money, but cultivation on a large scale requires a considerable outlay.

CONCLUSIONS.

As a native drug plant of admitted commercial value and one which is rapidly becoming scarce in its natural locations through clearly recognized economic causes that are not likely to cease, goldenseal appears to be well worth cultivating whenever market prices indicate reasonable returns.

Regarded as a minor money crop, goldenseal is well adapted for small growers who can meet the special requirements of the plant, though it makes its chief appeal, perhaps, to ginseng growers, who are already equipped for the culture of exacting woodland plants, but who, because of the pests and diseases which attack ginseng, may find in goldenseal an admirable side or succession crop.

Assuming a possible yield of 1 ton of dry root to the acre and an average of four years for the root to mature from seed or root propagation, not more than 500 acres would be needed to produce the 100 tons, more or less, of dried root which is the estimated annual consumption. This makes no provision for competition with the wild supply of root, which, though believed to be rapidly decreasing, is still an important factor. Overproduction would quickly be followed by falling prices, and prospective planters should bear in mind the commercial limitations of a crop of this character.

Prospective goldenseal growers should study the methods adopted by those who have been successful with ginseng and plan their equipments accordingly, as goldenseal requires essentially the same conditions as ginseng but may be regarded generally as a less difficult crop to grow.

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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 613

GOLDENSEAL UNDER CULTIVATION

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Prospective goldenseal growers should study the methods adopted by those who have been successful with ginseng and plan their equipment accordingly, as goldenseal requires essentially the same conditions as ginseng but may be regarded generally as a less difficult crop to grow.

This bulletin is of interest to residents of the Eastern, North Central, and North Pacific Coast States.

Washington, D. C.

Issued October 1914
Revised June 1936

GOLDENSEAL UNDER CULTIVATION

By WALTER VAN FLEET, *physiologist, Drug-Plant and Poisonous-Plant Investigations, Bureau of Plant Industry* [1]

CONTENTS

DESCRIPTION OF THE GOLDENSEAL PLANT

GOLDENSEAL, known botanically as *Hydrastis canadensis*, is a perennial, with a short, yellow rootstock prominently marked with seallike depressions caused by the falling away of the annual stems. A great many popular names have been given the plant in the past, but goldenseal and hydrastis are now most commonly used.

The stems of goldenseal grow to a foot or more in height and bear two (or rarely three) large, slightly hairy, five-parted leaves. The stems are purplish and hairy above the ground, but below the soil surface they are yellow, like the roots.

In early May, before the leaves are fully developed, a single, small, greenish-white flower appears on a short branch, or rather on the continuation of the stem above the upper leaf. This flower develops into a berrylike fruiting head, bright red in color when fully ripe, which resembles a large raspberry. Each fruit may contain from 10 to 30 black seeds, somewhat smaller than buckwheat grains. Several stems are commonly sent up by the stronger rootstocks, but as a rule only one flower head is developed. In old clumps, as well as on young and weak plants, there are many stems which bear a single leaf but no flower. The stems and leaves usually die down soon after the fruit ripens, but in moist seasons favorable to late growth they may persist until frost. Winter buds, generally two in number, form near the base of each stem. These buds perpetuate the growth next season, but as a rule only one bud starts in the spring, the others acting as a reserve in case of accident.

The fresh rootstock is rarely over 2 inches in length and is about three-fourths of an inch in thickness, giving forth at the sides a profusion of fibrous yellow roots a foot or more in length (fig. 1). It contains a considerable quantity of yellow juice, rather rank in odor, which was formerly used as a dye. When dried, the rootstock

[1] Revised by A. F. Sievers, senior biochemist, Division of Drug and Related Plants.

shrinks to about one-fourth of an inch in diameter and becomes hard, knotty, and wrinkled. The dried rootlets are very brittle and break away from the rootstock unless carefully handled. This "fiber", as it is commercially termed, has medicinal value equal to that of the rootstock but brings only about half the price when separated from it.

HABITAT AND RANGE

Goldenseal is native to open woodlands where there is ample shade, good natural drainage, and an abundance of leafmold. Its range is from southern New York and Ontario west to Minnesota and south to Georgia and Kentucky, ascending to higher altitudes as its southern limits are approached. The most abundant centers of distribution are in Ohio, Indiana, West Virginia, and Kentucky.

FIGURE 1.—Mature root of goldenseal.

In its natural situations goldenseal often grows in dense patches of considerable area, spreading through the loose mold by means of root buds which form irregularly on the long fibrous roots that penetrate the soil in all directions, the growth following chiefly the lines of least resistance, as, for example, along the sides of decayed fallen trees or in the spaces between loose rocks (fig. 2). The rootstocks, too, decay with age and break up into several growing points, which eventually form independent plants.

COMMERCIAL HISTORY

Goldenseal was commonly used by the Indians and early settlers of eastern North America as a remedy for sore mouth and inflamed eyes, and also as a bitter tonic in stomach and liver troubles, but there was little commercial demand for the root until about 1860. Since that time its use has become world-wide, though by far the greater quantity of the crude drug, both wild and cultivated, is consumed in this country.

Until about the year 1880 the prices paid for crude goldenseal rarely ranged over 8 to 12 cents a pound, these prices, as a matter of course, being based on the actual cost of collecting and curing the material in the localities where it was most abundant. In 1890, however, the approaching scarcity of the root was manifested by rising prices, and at the close of the next decade the cost had advanced to an average of 58 cents a pound. Early in 1904 the price passed the dollar mark, the year closing with wholesale quotations ranging from \$1.35 to \$1.50 a pound. Thereafter, with the exception of slightly retrograde fluctuations in 1912, which were apparently the direct result of overcollection, there was a steady advance in the price of the dried root, both wild and cultivated, until 1920, when its market value exceeded \$6 a pound. Following this, a decline set in for a few years, lasting until 1924, when the lowest quotation was \$2.50 a pound. For several years thereafter the market improved somewhat, the best quality of root bringing up to \$4.50, until 1928, when a steady

FIGURE 2.—Goldenseal in forest growth, 4 years old.

decline began which continued until 1932, when the prevailing price dropped below \$1 a pound. Since then there has been some recovery, but returns to growers up to the summer of 1935 were entirely inadequate, considering the rather exacting requirements of the plant and its relatively slow progress toward commercial maturity.

It is commonly thought that the wild root is now so near extermination throughout the greater part of its range that it can never again prove an important factor in the market. Natural reproduction is slow, even under the most favorable conditions, and the plants are singularly defenseless against the encroachment of the more vigorous vegetation which invades forest lands that are disturbed by clearing and pasturage. There has, however, been a very considerable increase in the cultivation of the plant, and this has undoubtedly been responsible to a large extent for the great decline in the market value of the root.

The herb (leaves and stems) also has some market value. Since 1923 the highest annual quotations for this product have ranged from 15 cents a pound in recent years to 85 cents in 1926.

PRODUCTION OF GOLDENSEAL

In commerce and in culture goldenseal is closely associated with native ginseng, as they both grow in essentially similar locations and have long been collected by the same drug-root hunters. When, therefore, the cultivation of goldenseal began, about 30 years ago, it was naturally taken up by the ginseng growers, who, because of several years' experience in growing ginseng, were well informed concerning the needs of woodland plants. While the cultural requirements of goldenseal are very similar to those of ginseng, goldenseal appears on the whole to be the less difficult plant to grow. The seeds, when properly treated, grow the following season. The roots are rarely injured by mice, which occasion considerable local losses to ginseng growers, and the plant, as a whole, appears to be far less subject to disease. As compared with ordinary garden crops, however, goldenseal is not an easy plant to grow, but requires special care and suitable conditions at all stages of its development.

PREPARATION OF THE SOIL

The soil in which goldenseal is grown should be well fertilized, preferably by the use of decaying vegetable matter such as woods soil and rotting forest leaves, which should be well worked in to a depth of 10 inches or more. Raw bonemeal and cottonseed meal are favorable in their action and have also the great advantage of not introducing weed seeds. Both may be applied at the rate of half a pound to each square yard of bed surface or something over 1 ton to the acre. The best means of supplying the indispensable element, potash, appears to be by using the sulphate at the rate of 2 ounces to the square yard or 600 pounds per acre. Acid phosphate, or dissolved rock, and the various commercial fertilizer mixtures containing it do not appear to suit goldenseal, nor do wood ashes, probably on account of the neutralizing effect of their lime content. These fertilizers—leafmold, bonemeal, cottonseed meal, and sulphate of potash—should, if possible, be well mixed with the soil 2 weeks or more before setting the plants. If needed, smaller quantities may be applied subsequently as top dressings and lightly worked in.

Thoroughly rotted stable manure applied in early spring as a mulch or incorporated into the soil before planting greatly stimulates growth, but sometimes it appears to favor the decay of the crowns and frequently introduces troublesome weeds. For these reasons it is little used by the more experienced growers.

If the soil is of close texture, leafmold should be used with great liberality; a covering 4 inches deep, with an additional inch or two of sand, is not too much to incorporate when preparing the beds.

For seedbed purposes sufficient sand and leafmold should be used to prevent baking after heavy rains, but it is best to omit all other fertilizing material. Seedbeds need not be worked deeper than 6 inches, as it is not desirable to have them settle to any great extent.

Plant beds should be formed sufficiently high in the center to shed rain, but it is perhaps not well to make them extremely convex for the purpose of gaining greater planting surface, as the steep slopes dry out too rapidly. Plants may be set 6 to 8 inches apart each way, covering the rootstocks about 2 inches deep. Seedlings and root cuttings may be set 3 inches apart at first and afforded greater space when next transplanted.

PROPAGATION

Goldenseal is propagated by means of seeds, by division of the rootstocks at the dormant period, and by buds or young plants formed from the stronger fibrous roots. Of the three methods, division of the rootstock is perhaps the one most frequently used, as two or more buds usually form near the scar left by the stem when the top decays after the summer's growth and it is only necessary to cut apart the rootstock, taking care that a few good roots are secured with each bud or growing point. The portions of the rootstocks with the accompanying rootlets which do not possess buds, or "eyes", may be dried for market. It is the usual practice when digging beds of cultivated goldenseal or when handling the fresh wild root to use for replanting all buds that can be spared from the drying stock. From rootstocks of marketable age an increase of 200 to 300 percent of propagating material may thus usually be had and a fair surplus of root left for drying. When used for purposes of propagation only, the beds may be dug over each year and the rootstocks divided, an increase of about 100 percent being thus obtained under favorable conditions.

ROOT-BUD PROPAGATION

The buds and plants which form on the stronger fibrous roots are very irregularly distributed and occur from 2 inches to a foot from the rootstock. Naturally they are most abundant on the roots of plants which have not been disturbed for several years and which in time form the matted growths that are found in undisturbed wild colonies and in old beds under cultivation. These plants are usually quite small but may be half an inch or more in height. The larger ones may be planted with the main crop, while the smaller ones are best set under shade, about 3 inches apart. They may be placed in boxes or in beds of prepared light soil with a good proportion of leafmold, where they may be allowed to grow until large enough to transplant to the regular beds. The plants should be dibbled in, with the growing point an inch or so below the surface. Under ordinary conditions the yield from root buds should add from 50 to 75 percent of the annual increase. These buds are often quite obscure in form, but practically any healthy thickening on a goldenseal root may be expected to produce a plant if given a fair chance.

PROPAGATION BY SEED

The earlier goldenseal growers did not greatly favor propagation by seeds, which are rather scarce in nature, owing to the dense growth of many of the wild stands and the frequent destruction of the ripening berries by birds and forest animals. The seeds when gathered were often allowed to dry before they were planted, or they became injured by too-rapid fermentation of the fleshy coatings if stratified with a scanty amount of sand or similar inert material. Plantings in forest seedbeds appeared to give poor results, owing to various disturbing causes, even when the seeds were in good condition. Under cultivation, however, seeds are freely produced, owing to the better spacing of the plants and their security from birds and animals; if properly handled, seeds should germinate with vigor the following spring, or earlier if sown under glass.

The berries or seed heads should be picked as soon as they begin to show color, and when a sufficient quantity has been obtained it is probably best to knead them in a bag or run them through a fruit squeezer set so as not to crush the seeds and thus get rid of the fermentable materials in the juice and pulp. The residue, consisting of the skins and seeds, may be mixed with 10 times its bulk of sand or sifted woods soil and stratified in well-drained pots or boxes. These should be covered with fine wire netting, to exclude vermin, and kept in a cool, moist cellar or buried in the soil in a shady place free from standing water. The soft parts soon rot away, leaving the seeds in their naturally moist condition, fresh, plump, and bright.

The seeds may be sown in October in a well-prepared seedbed containing a large proportion of sifted woods soil worked in to a depth of 6 inches. They may be scattered broadcast with the stratifying material or sifted out and dropped one-half inch apart in rows about 6 inches apart. The seeds should then be pressed into the moist soil with the flat side or edge of a board and covered with fine leafmold to the depth of an inch. Burlap or old fertilizer sacks make a very good winter covering for the beds, keeping in the moisture and protecting the seeds from being washed out by the drip from boughs, or from laths, if under an artificial shade. A mulch of leaves or moss may be placed over the burlap during frosty weather to lessen the danger of heaving. Seedbeds should be especially well protected by means of slates, boards, or wire netting set deep into the ground against the encroachment of moles or mice. They should also be protected against trampling, as the sprouting seeds are readily injured by such disturbance.

Should the quantity of seeds gathered at any one time appear too small for pressing, the berries may be partially dried and stratified with a large quantity of nearly dry soil or sand. In this way the intense fermentation that may occur when the fresh fruits are stratified with only a small quantity of inert material is avoided. On no account should the seeds be allowed to become entirely dry, as they will then probably fail to germinate, even under the best conditions. When stratified, the half-dried berries or seeds should be disposed in alternate layers with sand or mold, the layer of mold being much the thicker. The receptacles should occasionally be examined to ascertain whether the contents are likely to dry out.

When goldenseal seed is sown in the open, whether under lath shade or in the forest seedbed, during the first season the seedlings rarely get beyond the seed-leaf stage, the true leaves appearing the following spring (fig. 3). If, however, the seeds are planted under glass at the beginning of the year and have night temperatures of about 55° F., with a proportionate rise during the day, and adequate shade in the following summer, sufficient progress may be made by the close of the season to develop good-sized leaves, with rootstocks large enough to plant out in the beds.

In the experiments of the Department of Agriculture there have been grown in a single 10-inch pot, in 10 months, as many as 50 vigorous seedlings (fig. 4), with from one to three buds to a single rootstock and with roots more than a foot in length (fig. 5). These seedlings were grown from properly stratified seeds which were col-

FIGURE 3.—Goldenseal plant grown under a lath shed, second year.

lected in August and sown the first week in the following January in a compost of equal parts of leafmold and loamy garden soil.

Low greenhouses, such as are used for growing ordinary vegetable plants in midwinter and early spring, would afford congenial conditions for goldenseal. Since greenhouses of this type may be built at small cost, it may be questioned whether such glass protection for the seedlings would not be a real economy, considering the saving in time and the gain in vigor of the plants.

When collected in small quantities, the fresh berries may be broken apart and at once planted in pots or seedbeds, or the seeds may be washed out and immediately planted, but the results are rarely as good as when the seeds are stratified. On no account should the berries be planted whole, as the seedlings, if they come up well, will be too crowded for satisfactory development.

SHADE

When well established in favorable soil, goldenseal will endure nearly full sunlight, but for satisfactory growth it requires about

FIGURE 4.—Goldenseal seedlings grown under glass, 5 months from sowing.

75 percent of shade in summer, though much less will answer in spring. In other words, three-fourths of the sun's rays should be excluded in summer, either by forest shade or by structures of convenient height covered with laths, cloth, brush, or vines sufficient for the purpose. In northern sections less shade is thought necessary than in southern localities. The shade should be open to the north and also to the east in order to permit the greatest amount of ventilation, but should be covered at the top and on the south and west sides with brush, boards, or laths spaced so as to exclude about three-fourths of the sunlight. Very heavy burlap has been used with fair success for shading woodland plants, but thin or ordinary muslins do not intercept enough light, while they frequently appear to retain heat to an injurious degree. In the North, where open construction is preferred, use can be made of grapevines, lima beans, or

morning-glories, which may be planted on the south and west sides and allowed to run on wire netting, thus furnishing shade during the bright summer months; but the grapes at least should stand at some distance from the arbor, in order that the feeding roots may not interfere with the goldenseal.

There are many methods of obtaining the necessary shade, the most common being to set posts of durable wood firmly in the ground 8 feet apart each way, rising about 7 feet above the soil surface. Scantlings 2 by 4 inches in size are nailed on top of the posts, running the long way of the shed. The shade is usually provided in sections 4 by 8 feet long and consists of common 4-foot laths or slats nailed on strips 2 by 2 inches and 8 feet long. The laths should be spaced from one-fourth to one-half inch apart, according to whether the locality is in the North or in the South. These sections of the shading structure are laid on top of the 2- by 4-inch runners and are so nailed or tied to the posts that the laths run nearly north and south, thus giving the plants below the benefit of constantly alternating light and shade. When the sections are wired or tied instead of being nailed fast to the runners, they may be taken off and stored during the winter, thus adding greatly to their durability and avoiding damage to the sheds from heavy snowfalls.

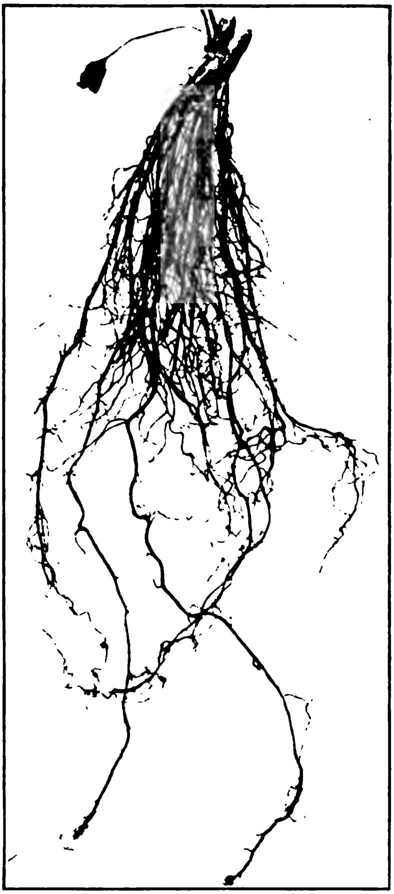

FIGURE 5.—Pot-grown root of goldenseal, 10 months old.

For covering the seedbeds a rather low shade is desirable, in order to prevent the washing out of the seeds by the drip from the laths. Poultry netting covered with brush, straw, litter, or burlap—just a little in the spring and more as the sun grows hotter—answers the purpose very well.

The beds under shade are made about 4 feet wide and preferably run east and west, being so placed that the drip from the ends of the laths will, to a great extent, fall in the paths. The sides of the beds are usually made of 12-inch boards set at least 8 inches in the ground, to keep out moles, and held in place by small stakes. The soil should be fairly light and so well drained, naturally or artifically, that water can at no time remain on the surface of the beds. Should artificial drainage seem necessary, one or more lines of small tiles may be placed under each bed, discharging at points low enough to carry away all surplus soil water. The soil should be in good tilth and rich enough to grow at least ordinary vegetables without the addition of strong manures.

VENTILATION

Forest plantings secure the natural ventilation which is required by the goldenseal plant, and in all artificial shading provision must be made for the free circulation of air, particularly in moist or cloudy weather. Protection from direct sunlight overhead and on the south and west is all that is needed. The northern and eastern aspects of all shading structures should, as a rule, be open, and whenever possible the air movement should be unobstructed by nearby buildings or plantings other than those furnishing the necessary shade. The height of lath houses or other shading appliances, except in the case of seedbed protection, should be sufficient to allow a good circulation of air and also a convenient working space. Seven feet of clearance above the path levels is sufficient for the purpose. In exposed situations a windbreak of timber, trees, or shrubbery a few feet from the shading structure in the direction of the prevailing windstorms may be of great service in preventing damage to the tender growth without greatly reducing the ventilation requirements.

MULCHING

Summer mulches of buckwheat hulls or well-rotted hickory, maple, or basswood sawdust are especially favorable for seedbeds and young plants, as such materials greatly conserve the soil moisture and prevent much weed growth. Sawdust from pine or oak is not considered desirable. Of more importance, however, is the winter mulch of leaves, bean vines, cowpea hay, or other coarse litter not containing weed seeds or material attractive to mice, as it lessens heaving and the undue frosting of the crowns, and as a protection from the drying winter winds it is quite in accordance with the natural woodland conditions. Winter mulches are particularly necessary for seedbeds, 4 or 5 inches of leaves or their equivalent in litter being ample for the severest climates, while less is needed in the South. As a rule, the material need not be placed in position until actual freezing is imminent and should be removed in the spring before the first shoots come through the soil.

ATTENTION REQUIRED

Aside from having the beds kept free from weeds and other interfering vegetation at all times during the growing season, goldenseal needs little attention. If loose mulches of fine materials, such as buckwheat hulls or old sawdust, are used, they may be allowed to remain during the summer and will go far toward suppressing weed growth. If the mulch is thin and the soil shows signs of crusting during dry weather, the earth may be lightly stirred with a suitable tool, but deep culture at any time is likely to do more harm than good by breaking up the mat of fibrous roots that run near the surface.

Goldenseal has a relatively short growing season, and its growth may be seriously checked by untimely droughts. Liberal applications of water at such critical times—applying enough at once to soak the beds thoroughly—may make the difference between partial failure and a successful season's growth. Growers of goldenseal may well consider the advantages of dry-weather irrigation where it appears to be practicable.

FOREST-BED CULTURE

After passing the seedling stage, goldenseal is well adapted to forest culture, as the plants are not preyed upon by wood mice, which so often work serious havoc with the tuberous roots of ginseng. The location selected should have good drainage, as the plants, though fond of moisture, do not thrive in boggy ground. It should be well shaded by tall trees rather than by undergrowth. Oak, maple, sycamore, and basswood afford very suitable shade; but pine, spruce, hemlock, and similar trees should be avoided.

The plot should be deeply plowed or spaded and all tree roots removed to the depth of a foot or more, future encroachment of the roots being reduced by cutting around the beds each year with a sharp spade. In addition to the natural coatings, a liberal dressing of leaf-mold or well-decayed litter should be worked deep into the soil, and it is well also to rake in bonemeal and sulphate of potash at the rate of 10 and 4 pounds, respectively, to the square rod when finishing off the beds. The plants should be set in the same manner and at the same distance apart as those under artificial shade.

Except that forest beds require more frequent supplies of plant food and water on account of the competition of tree roots, cultural treatment is in all respects similar to lath-shed plantings, even including the winter mulch of fallen leaves if it is not sufficiently supplied by nature.

DIGGING AND CURING

The roots may be dug at any time in the autumn after the tops have died down. It is best to take up the beds solidly when of sufficient age, as the root buds and small plants are generally abundant enough to reset if it is thought desirable.

The rootstocks and attached rootlets are washed clean of all soil and freed from sticks, pebbles, or other foreign matter lodged in the fibrous masses. All buds and divisions needed for further propagation should be removed before they become dry. The rootstocks are conveniently dried on lath screens in an airy place in mild sun or partial shade, or indoors on a large, clean, dry floor. They should be turned several times daily until thoroughly dried. When dried in the open they should be protected from dew at night and taken under cover on the approach of rain. In very dull weather it may be well to finish the drying in a heated room with a temperature of about 80° F.

The cured root is best kept in rather loose masses in a dry, airy place secure from vermin until ready for market. If closely packed while at all moist it may be attacked by mold, which greatly lessens its value. Thoroughly dry root may be shipped safely if tightly packed in bags or boxes, or in barrels well lined with paper.

The market is found with the crude-drug dealers and manufacturing druggists in most large cities. Goldenseal root is also handled on commission and is readily purchased by fur buyers and traders in miscellaneous forest products.

DISEASES [3] AND PESTS

Of the several diseases occurring on this plant, the most common and destructive is botrytis blight. This disease is prevalent in New York, Ohio, Michigan, Indiana, Wisconsin, and doubtless other areas where goldenseal is grown. It will be found in most gardens, but is noticeably destructive only in wet seasons. At times it kills 10 to 20 percent of the tops. All parts of the plant are attacked, including rootstocks, leaves, blossoms, and seed heads. Seedlings are often destroyed. The blighting of the leaves and the rotting of the petioles at the base are the symptoms most commonly observed. It should be noted that this disease does not attack ginseng as commonly supposed, nor does the well-known Alternaria blight of ginseng infect goldenseal. Bordeaux mixture and other standard fungicides give partial protection, but cannot be relied upon for complete control, particularly in wet seasons. As an additional measure infected beds in the fall of the year should be cleared of all mulching material in which the fungus is able to carry over, together with the tops of the plants themselves. If the disease has been severe, copper sulphate solution at the rate of 1 pound to 10 gallons of water might be sprayed over the beds before the mulch is replaced. All diseased material should be burned or removed to a considerable distance from the garden.

Other diseases are of minor importance, and measures adopted to control botrytis blight will ordinarily hold them in check sufficiently well. Careful attention to the suggestions given in this bulletin for proper shading, ventilation, mulching, and other cultural requirements will do much to obviate loss from fungus diseases.

The growing plants are subject to checks by drought, the tops dying down long before the normal close of the growing season, but without greatly affecting the underground portions. Slugs and earthworms disturb the seedlings, the slugs eating the crowns down to the rootstocks. Moles also may cause loss by upheaving the beds. Irrigation is the rational cure for drought, and cautious applications of lime will reduce the annoyance from worms and slugs, but the best means of controlling the latter is to pick them off by hand at night with the aid of a lantern. The moles may be trapped, or, better, may be kept out entirely by bordering the beds with slates, boards, or fine wire netting set 8 inches or more in the ground.

The roots of goldenseal are subject to root gall and the plant cannot therefore be safely used as a succession crop for ginseng beds which are infected with the gall.

TIME REQUIRED TO PRODUCE A CROP

Under favorable cultural conditions goldenseal reaches its best development for market in about 5 years from the germination of the seeds, or a year or two less when grown from root buds or by division of the rootstock. After the fourth year decay of the center or of the older parts of the rootstock may set in, thus offsetting the natural increase in size and weight. This decay of the old rootstock

[3] The information on diseases was prepared by John A. Stevenson, senior mycologist, Division of Mycology and Disease Survey, Bureau of Plant Industry.

has its compensation where increase of plants is desired, but from the market standpoint it is objectionable.

Goldenseal is valued solely for its remedial properties, and age depreciates rather than enhances the trade value of the root after reasonable maturity has been reached.

YIELD AND COST

Reliable information regarding the yield of roots that may be expected from an acre of goldenseal is not generally available. Experiments conducted by the Office of Drug Plant Investigations at the Arlington Experiment Farm near Rosslyn, Va., on small plots under lath shade have given yields at the rate of about 5,000 pounds of green root to the acre, representing nearly 1,500 pounds of dried root. The conditions at this place, however, are far from ideal for forest-loving plants. Successful growers of goldenseal have outputs of dry root at the rate of 2,000 pounds per acre at 5 years from seed. Possibly such yields may not be greatly exceeded in large plantings, but well-equipped small growers who can give their crops special attention may make much better showings.

The cost of goldenseal culture is necessarily greatly controlled by special conditions, the chief of which are the local costs of labor, lumber, and fertilizing materials. The outlay for starting a plantation is about $1,500 per acre, exclusive of the value of the land. This includes the average cost for propagating material, but makes no provision for irrigation or watering during dry weather.

The preparation of the forest beds usually represents an outlay approaching $200 per acre, with such additional expenses as may be necessary for protection, fertilization, and irrigation, as the live tree roots are greedy absorbers of plant food and water and always appropriate a considerable share of the fertilizers applied.

Small home and experimental plantings usually may be initiated with very little expenditure of money, but cultivation on a large scale requires a considerable outlay.

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FARMERS' BULLETIN

614

Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.
November 13, 1914.

A CORN-BELT FARMING SYSTEM WHICH SAVES HARVEST LABOR BY HOGGING DOWN CROPS.

By J. A. Drake, *Agriculturist, Office of Farm Management.*

INTRODUCTION.

The system of farming herein outlined provides productive labor for practically the entire year and at the same time so distributes this labor as to make it possible for one man, practically without hired help, to handle a large acreage, making a net income considerably greater than is at present commonly obtained on farms of similar size in the corn-belt States (fig. 1). This system rapidly increases the productiveness of the land and is designed to conserve soil fertility to the greatest possible degree. It affords a solution for some urgent and difficult farm problems.

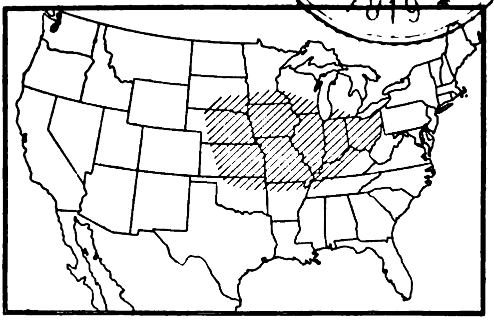

Fig. 1.—Map of the United States showing, by shaded lines, the territory to which this bulletin is applicable.

Labor in itself constitutes one of the hardest problems encountered on the average farm. Not only is this now true, but the situation seems to be growing more serious each year. The cost of extra labor is becoming greater, and efficient labor on the farm is more difficult to secure when needed most. Transient labor for the general farm is very unsatisfactory. As a rule, also, it is not convenient or profitable to keep the necessary extra labor throughout the entire year, even if it were available. This condition must soon result in the reorganization of a large number of farms throughout the corn belt, and in other sections as well. The main features of these changes must be (1) a better distribution of labor throughout the entire season and (2) systems that will reduce the extra labor required at certain critical seasons of the year to a minimum.

The average corn-belt farm must be devoted largely to the growing of staple field crops, such as can be planted and cultivated by machinery and handled on a large scale. There is little place in that

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region for crops that yield a big income per acre, such as truck crops and small fruits, except in a few localities close to cities, where good markets are available. The tendency in most sections is for the labor of the farm to be done by one man or by one man and his family. Occasionally it is done by the owner or tenant and a hired man. In this case it is rare that the hired man can be depended upon to stay the entire year, unless he has a family and is furnished a place to live. In any event, it is growing more imperative that the efficiency of the one man be increased as much as possible in such operations as plowing, planting, and cultivating the farm crops, and that all the labor possible be eliminated in the harvesting of these crops, in order to cover a greater acreage effectively and at the same time to use the greatest economy in the employment of outside labor, inasmuch as it is so difficult to secure.

Already this has given rise to certain well-formed and definite systems which include these elements as prominent features in the management of the farm. In several widely separated places practically the same system has been worked out. In all of these instances 3 and 4 horse machinery is being rapidly substituted for that of the 2-horse type, in order to double the efficiency of each man employed. Crops are being grown that do not compete for labor. Live stock is being used in every way possible in the harvesting of the crops produced, thus eliminating to a very great extent the necessity of hiring extra labor. By this process, also, the soil is being brought to a higher stage of productiveness.

THE CROPPING SYSTEM.

A system which meets the requirements of the average conditions in the corn belt has been found in actual operation on a number of widely separated farms. It is one of the most definite and clearly defined systems that have been encountered during several years of farm-management studies throughout the region. It has been devised by the farmers themselves, as they have been forced gradually to meet present conditions.

The system in itself is very simple. Only three different crops are grown, and these follow in a 4 or 5 year rotation that is easily managed. The crops are corn, rye, and a mixture of clover and timothy, or clover alone, as is thought best. The rotation in its 4-year form is corn, corn, rye, and timothy and clover. The 5-year rotation is the same, with the exception that the clover and timothy are allowed to stand two years instead of one.

The ease with which the labor of such a rotation is taken care of is very evident. Corn is the first and only crop to receive attention during the spring and early summer until time to lay it by, at which time hay harvest begins. Since the rye is harvested later by the hogs, there is nothing to correspond to the wheat harvest, which always comes at about the time the corn crop should be given its last cultivation. Haying, then, is the only job to look after from the time the corn is laid by until it is necessary to cut corn or sow the fall grain, which in this case is rye. Thus the program is not crowded, and each crop can have its due attention without rushing or slighting any part of the work. This makes it possible for a given crew to handle a maximum acreage with the least possible expense for outside help.

In order that a clear and definite understanding may be had of the entire system, its rotations, the layout of the fields, and the methods of handling the live stock, a diagram with fields numbered and crops indicated is presented herewith (fig. 2).

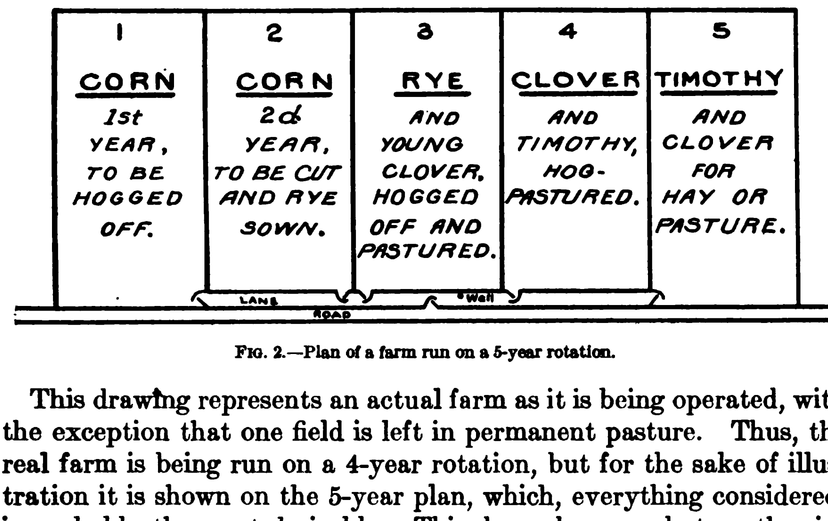

FIG. 2.—Plan of a farm run on a 5-year rotation.

This drawing represents an actual farm as it is being operated, with the exception that one field is left in permanent pasture. Thus, the real farm is being run on a 4-year rotation, but for the sake of illustration it is shown on the 5-year plan, which, everything considered, is probably the most desirable. This depends somewhat on the size of the farm. If the farm is of sufficient size, a sixth field may well be added and devoted to permanent pasture.

As the crops are arranged in the drawing, the rotation moves one field to the right each year. The details of the crop management are as follows:

Field No. 1.—The crop in field No. 1 is first-year corn, or corn the first year after sod. This corn is grown and hogged off as soon as it is ripe. This process generally begins as soon as the corn has become hard and as soon as the hogs can be brought up to full feed, or about September 1 to 10. On some farms the commendable practice is followed of sowing soy beans or rape, or both, at the last cultivation of the corn, in order to furnish pasturage for the hogs while gathering the corn crop. Generally this will furnish a large amount of forage, and it is valuable not only on this account, but because of the humus-forming material it affords that will be turned back into the soil. The success of this practice depends somewhat on local conditions, but it comes in so nicely with the hogging down of the corn and requires so little labor that it is worth a thorough trial. The following spring the stalks and trash that remain on the surface of the field are cut over with a sharp disk. This is the first step in the preparation of this field for the second-year corn to follow.

Field No. 2.—Field No. 2 is devoted to second-year corn, or corn following the year previous. Rye must be sown here in the fall in order to furnish a field of rye for the next season, which, in turn, affords a ready means of getting a stand of clover and timothy. If it is a normal season and the corn stands well, the rye may be sown in the standing corn with a 1-horse drill. If this is not possible, the corn must be cut as early as is allowable, the ground prepared, and the rye sown after the corn has been cut and shocked. If corn cutting comes late, the rye may be sown late also and still give very good results. Rye may be sown much later than wheat with much more certainty of success. In some instances it is sown so late that it does not come up until the next spring, and still it produces a fair crop. This, however, is not desirable if it can be avoided.

Field No. 3.—Field No. 3 is devoted to rye during the entire season. In the fall of the year previous, timothy is sown with the rye, and the clover is sown in the rye early the next spring, preferably in February. During the spring the rye is pastured by the hogs as long as it is palatable. It affords excellent pasturage, which is quite valuable for young hogs and brood sows. As soon as it becomes tough the hogs will begin to chew it for the juices and throw the remainder out on the ground. This is a sign that they have derived about all the benefit they are capable of getting from the green pasturage. They are then taken out and are not returned to the field until about two weeks after the rye has ripened. Then they are allowed to gather the entire crop of rye and graze on the young clover that has come up from the spring seeding. The hogging down of rye is discussed in full later under the heading "The rye crop."

Field No. 4.—The clover and timothy in field No. 4 in a 5-year rotation are devoted entirely to hog pasture. Where this plan is used with a 4-year rotation, as is often done, the grass crop on this field must furnish both pasture for the hogs and hay for the horses and for the cows kept for family use. Hence, it is seen to be an advantage to sow a mixture of clover and timothy instead of clover alone. The hogs graze principally on the clover and leave most of the timothy to be cut for hay. A good cutting of mixed hay can generally be taken from the best parts of the field. This will usually be sufficient for the horses and cows.

Field No. 5.—The clover and timothy in field No. 5 occupy the ground for the second year. It should be nearly all timothy, though sometimes a good deal of clover may be present also. The grass crop on this field is cut for hay and may be sold. Late in the fall it is plowed for the first-year corn, which follows the next year. If not pastured too closely, this affords an excellent opportunity to plow under a good second growth of grass that will be very beneficial to the land.

THE SYSTEM OF LIVE-STOCK MANAGEMENT.

The principal live stock to be kept on a farm using this system is swine. The fall pigs are turned in on the rye in field No. 3 as early in the spring as is permissible. This is generally from April 10 to 15.

The sows and their spring litters are turned out on a part of the rye field or a small bluegrass pasture as soon as the pigs are old enough to travel well and are approaching the weaning age. When they are from 6 to 8 weeks old they are weaned and the sows taken to other inclosures, where they are bred for fall litters.

The fall shotes and the spring pigs remain on the rye as long as it is tender and succulent. This varies somewhat with the season, but generally throughout the corn belt the rye has become so woody by May 1 to 15 that it no longer affords good pasturage, and at this time the hogs are turned from the rye field, shown in the illustration as field No. 3, into the first-year clover and timothy in field No. 4. There they receive a reasonably liberal corn ration.[1] This is continued until fully two weeks have elapsed after the rye has ripened in field No. 3. This is generally about July 15. At this time the young hogs, and very often the brood sows also, are all turned into the ripe rye and allowed to hog it down and to eat the young clover along with it. While engaged in this operation they are given no corn or slop feeds whatever, and the only attention they require is to be given plenty of fresh water.

As a working basis on which calculations may be made, it has been found that six 100-pound hogs to the acre will gather a 17-bushel per acre crop of rye in six weeks. Timed in this way, the hogs will have the average rye crop harvested by September 1, at which time new corn is about ready to feed. Then, as soon as the hogs can be brought up to full feed on the new corn, or about September 10, they are turned into the first-year corn in field No. 1. There they remain until the field is hogged off or they are sold. This will be about November 1 to 10 if all the hogs are kept until the entire crop is gathered.

Many who have followed this system have found it advisable to take the fall shotes out of the rye and clover field about August 15 and allow them to finish out on old corn, thus getting them on the market before the rush of new-corn hogs. In this case the spring pigs are allowed to continue gathering the rye, and if any is left when they are turned into cornfield No. 1, the brood sows are turned in or are left in the rye field to clean it up.

Thus, the whole herd is furnished pasture and grain feed throughout the entire spring, summer, and fall, which the hogs have gathered with practically no labor and very little attention on the part of the owner or the man who operates the farm. Besides this, the brood sows and the fall litters are furnished pasturage on the rye field during the fall and early winter of the same year it is sown.

For the winter feeding of the fall pigs it is desirable to sow a few acres of soy beans. This may be done in the second-year cornfield or

[1] Two or three pounds of shelled corn (5 or 6 average ears) for each 100 pounds of live weight is about right.

on some small field set apart for that purpose. The most practical method of feeding this crop is to cut and stack the beans when ripe and feed them out as hay. Racks may be provided or they may be fed on the ground. The pigs are very fond of them, and if they are not fed in too great abundance none will be wasted. Soy beans fed in this way with corn make one of the most satisfactory winter feeds that can be grown or purchased on the market.

It may be desirable in some instances to enlarge on this farm system so as to include cattle or sheep or both in the live stock kept. This may be done by adding a sixth field to the plan proposed and allowing it to remain in permanent pasture. Dairying might be introduced into the system in localities favorable to this enterprise. If this is done, enough cows should be maintained to keep a second man practically busy with their care and management, since the crops and hogs keep one man well employed. Another live-stock enterprise suitable for combination with the system here outlined is the keeping of brood mares to do the work and raise colts. With any of these additional live-stock enterprises the farm should be of sufficient size to permit the sixth field to remain in permanent pasture and still allow the other fields to be of good size.

THE SIZE OF THE FIELDS.

In carrying out this system to the best advantage, the fields should not be less than about 20 acres. In a 4-year rotation this would call for 80 acres of tillable land and would just about represent a 1-man 3-horse farm in this latitude. In the 5-year rotation plan it would call for 100 acres of tillable land, and this could still be handled with the same working force. The sizes of the fields may be increased up to 40 acres, beyond which it is doubtful whether the acreage should be extended. If the fields are made to include 40 acres on the 4-year plan, it would call for 160 acres of tillable land, and on the 5-year plan there would be 200 acres in the rotation. If one field should be added and the same size maintained, there would be 240 acres in all. With this sixth field left in permanent pasture, the entire farm can be handled by one man with the assistance of a hired hand during the summer, provided he is equipped with a good 4-horse team and all machinery to correspond. The only extra labor that would be required would be while putting up 40 acres of hay and cutting and husking 40 acres of corn. If modern machinery is used, but little extra labor will be required, even for these operations.

By plowing one of the fields for corn late in the fall, such a plan is perfectly feasible, and there would be no rush season when the work could not be managed with a reasonable degree of comfort. To carry this out, it would be necessary to have the sows farrow their spring litters early in March, so as to require very little attention after the season for field work opens. The fall litters should be farrowed about September 1, as this is another time of year when work would not be pressing.

It will be seen that this system of managing a farm is capable of great possibilities in extending the area that one man can handle. For small farms it probably has less value, but it fits well into any scheme of farming medium and large acreages. It is especially suited to farms on which the labor conditions are difficult to meet and to farms that are in a low state of fertility. The method of disposing of half the corn and all the rye is such that it builds up the soil rapidly, and the labor saved in allowing the hogs to harvest these crops and a great part of the clover is a very important advantage over the ordinary system.

THE RYE CROP.

One of the very distinctive features of this farm system is the rye crop and the part it plays in the general details of management. There is no other crop that will fit in so well as rye and none that will take its place in carrying out this system in its most desirable form in the corn belt. In the first place it is a fall grain, which is absolutely necessary in order to get the most desirable distribution of labor. Wheat might fill this requirement, but there are many features about wheat that make it very much less desirable for this purpose than rye. Wheat is less certain to yield a good crop, and rye can be sown much later in the fall, if necessary, with greater assurance of success. Wheat can be hogged down in small acreages as well as rye, provided it is eaten quickly, before it has time to waste. The straw of wheat will break near the ground and allow the grain to lie flat on the ground, whereas rye straw breaks higher up and near the heads and thus keeps the grain off the soil, preventing it from rotting before the hogs have had time to gather it. When allowed to stand after it is ripe, wheat will shatter out, while rye will be retained in the heads until very late in the fall or early winter.

There is some objection to rye when used as outlined in this system in the dry regions of the West, on account of the grain remaining so hard that the hogs will not eat it, and, therefore, wheat for such sections is more desirable for hogging down than rye. But in the corn belt there is no trouble of this kind, provided the rye crop is allowed to stand in the field unmolested for a period of two weeks after it is ripe. When this is done, the beards lose their sharpness, the grain softens and becomes more palatable, and the hogs waste no time in taking hold of their new feed. This wait of two weeks is absolutely necessary, or there will be great disappointment in the hogging down of rye. Many have condemned the practice merely because this precaution was not observed. Another mistake that is often made is to feed corn when the hogs are gathering the rye, thinking that thereby their growth will be hastened. After the hogs have been on the rye for a few days the corn ration should be gradually lessened until none is fed. If corn is fed, the hogs will simply eat that much less rye.

Rye possesses other advantages over wheat. Aside from being a more certain crop, rye will do better on poor soil than wheat. In many sections of the corn belt wheat is hardly a profitable crop, and many farmers say they grow it merely in order to get a stand of clover and are inquiring what they must do to get away from raising wheat. Rye, when managed as it is in this system, offers a solution of this problem. It not only takes the place of the wheat crop where the yield of wheat is low and unprofitable, but it offers a better chance of success with the clover crop that is sown in it. Rye grows

FIG. 3.—Hogs grazing on rye in the spring.

tall and does not produce so dense a shade as wheat, and it therefore gives the clover a better opportunity to thrive.

In carrying out this general plan with the rye crop it is the most common practice to pasture it with the hogs for a while during the early spring. This is not only a beneficial thing for the hogs, but their trampling helps to sink the clover seed into the soil and is an important item in securing a stand of clover. Figure 3 shows a good bunch of pigs grazing on rye early in the spring and the splendid pasturage they are getting.

Another important feature about the practice of hogging down rye which must not be overlooked is its contribution toward the building up of the soil and the maintenance of soil fertility. All the rye straw and practically 80 per cent of the fertilizing value of the grain is immediately put back on the field and is better distributed than would be possible by any other system of feeding and distributing the manure. It is possible, even on poor land, to produce immense growths of rye straw with fair yields of grain. This straw furnishes great quantities of the vegetable matter and humus-forming material that is so essential to all soils. The crop of rye shown in figure 4 was grown on only medium soil with the aid of 200 pounds of acid phosphate per acre. Turning back such quantities of straw soon makes a decided change, even on very poor soil.

An item of no little importance is the ease with which the hogs take care of themselves while hogging off the rye crop and eating the young clover that has grown up therein. During the hot season of July and August the hogs lie in the shade during midday, but about sundown start out in the rye field and work there generally all night, coming in

FIG. 4.—A splendid growth of rye, with the hogging-down process just beginning.

late the following morning. If plenty of pure water is furnished them, this is all the attention they require, and they will continue to do the work of harvest hands very effectively.

Compared with the cost of harvesting, thrashing, and marketing the grain it has been determined that each hog will do about 1 cent's worth of work per day. This, taken into account with the fact that each hog will make a very creditable gain of one-half to three-fourths of a pound per day, and in some cases a pound, during a time when the labor situation is most tense, is a big factor in the economic management of the farm.

The composition of rye grain is about the same as that of corn, being only slightly higher in protein than corn. Young clover, when eaten with ripe rye, makes an excellent ration, which produces a smooth, "growthy" type of hog that is in just the right condition to put on fat rapidly when given a corn diet later.

Figure 5 shows a rye field that is nearly harvested and the splendid hogs that it has produced.

THE MONEY INCOME PER ACRE.

The money value of an acre of rye, whether hogged down or thrashed and sold on the market, is not great; hence, on smaller farms of 40 to 60 acres of fertile soil this crop with this method of management will not have so much place as on larger farms that are less productive. On the smaller farms it is desirable to grow crops that will bring a greater profit per acre, even though a greater outlay of labor is necessary. If, however, this demand for extra labor can

FIG. 5.—A field of rye and young clover nearly hogged off and the thrifty hogs that have been doing the work.

not be met, then rye and the practice of hogging it down still have a place on the smaller farm, and especially if such farms are in a run-down condition.

Under average conditions in the corn belt 17 bushels of rye per acre is a good yield. This, when sold on the market at 70 cents per bushel (which is a liberal standard price), will bring $11.90. The income when the crop is hogged down will vary with the price of hogs. With the young clover that grows up in the rye, a 17-bushel acre of rye will produce approximately 200 pounds of pork without any outside or supplementary feeds. This, when sold at 6 cents per pound, will bring $12 per acre, and at 7 cents, $14.

In collecting data on the income derived from an acre of rye when hogged down, it has been repeatedly shown that this is about the same as when the crop is cut, thrashed, and sold. Generally, there has been a slight advantage in favor of the hogging-down process. This varies somewhat, and in some cases this advantage has been considerable. In addition to yielding an equal or slightly greater money income, the hogging-down method permits the rye to stand throughout the hot, dry season and come down gradually, thus furnishing a protection for the young clover; it saves the labor involved in harvesting, thrashing, and marketing the crop, and is a very important means of building up the soil. Even if the two methods yield the same financial returns, that of hogging down the crop is decidedly superior, in that it protects the clover, builds up the soil, and saves the labor of harvesting, thrashing, and marketing the grain.

RYE OR WHEAT—WHICH?

There may be some question when this farm system is considered for the average corn-belt farm as to whether it is not better to continue growing wheat than to substitute rye with the practice of hogging it off. This is a question that must be worked out and answered separately on each farm.

In deciding this question there are many things that must be considered. The first is the man himself. Has the man who will operate the farm an inclination toward swine raising or a dislike for it? Has he or can he acquire sufficient skill in this to be reasonably sure of raising the number of hogs each year that would be required to harvest the rye crop? The next item is the equipment and fences on the farm. Is the farm so fenced or can it be so fenced that hogs of all sizes may be kept in all fields? Certain equipment for housing the brood sows and their litters will be necessary also. Is it desirable to furnish the fence and other equipment necessary, or continue more along crop-farming lines, of which wheat growing and selling shall be a part? Finally, the item of labor must be considered. Is there labor available to handle the wheat crop without seriously hindering the other farm operations? If not, even if it is more profitable, it may be advisable to substitute rye and the practice of hogging it down.

THE CORN CROP.

The corn crop is a very important factor in the success of this system. On farms where corn yields are extremely low this plan would require the purchase of a large amount of corn, and it might not be feasible until the soil has been built up to a point where a fair yield of corn may be expected. It might be better in such cases to run the farm as a grain farm, with such legumes as soy beans or cowpeas as cash crops, until the soil has been built up to at least a moderate degree of fertility by this means and by the use of such green manures and other soil amendments as the farmer can afford under the circumstances. An alternative would be to reduce the number of hogs in proportion to the corn yield, say to three or four for each acre of rye, instead of six. By doing this the rye will last longer and less corn will be required.

The possibility of securing at least fair yields of corn should be kept in mind in putting this plan in operation outside of the corn belt proper. With the precautions mentioned above, this system as a whole, or modifications of it, should be of value in the reorganization of a large number of farms in other sections as well.

The system proper should always include two fields of corn, as shown in figure 2. One field should be cut and shocked and later shredded, in order to furnish bedding, while the fodder is being fed in the barn. All or a part of the other field should be hogged down as it may seem wise to do under the circumstances at hand. All the fields in the rotation should be of approximately the same size. With this arrangement and corn yielding 60 bushels per acre, ample corn will be produced to meet the needs of the farm. If the yields are lower than this, the number of hogs must be cut down accordingly, or the difference made up by buying corn.

The practice of hogging down corn which is called for in this system of management is so prevalent throughout the corn belt that it is not necessary to discuss it at length.[1] Farmers have learned that when properly handled it is a most successful and profitable farm practice. It is not wasteful, it saves a great amount of labor during a rush season when outside labor is badly needed, and it immediately returns to the soil most of the fertility contained in the corn crop. In addition to this, by plowing down the cornstalks and the remaining vegetation left by the rape and soy beans sown in the corn, a large amount of vegetable matter is turned under, which is very important if crop yields are to be increased and maintained.

The general experience is that a part of the field should be set off by a temporary fence[2] and that the hogs should not be allowed to cover too large an area at one time. This precaution is a big factor in preventing waste, and it avoids the possibility of having to leave the field only partly gathered if it should become necessary to sell the hogs before the work is finished. This is especially desirable with this system, since only six hogs are to be raised for each acre of corn to be hogged off. In this case, it will take the six hogs, three of which will be fall shotes and three spring pigs, about 60 days to hog off an acre of corn yielding 60 bushels. Very often it may not be desirable to allow the hogs to cover more than one-half or two-thirds of the field. It would seem advisable, therefore, to fence off from 5 to 8 acres

[1] For a full discussion of the practice of hogging down corn, see Bulletin 143, Iowa Agricultural Experiment Station, and Bulletin 104, Minnesota Agricultural Experiment Station.

[2] This fencing is easily done by setting good anchor posts at each side of the field, stretching 25-inch woven-wire fence, and tying it to the hills of corn.

at a time and have this cleaned up well before moving the fence. It is good practice also to allow the brood sows and their fall litters to follow later to gather up what little waste corn may be left in the field.

When the hogging down of corn, properly managed, is combined with the hogging down of rye and the pasturing of clover, as outlined in this paper, the result is one of the most economical and efficient of farm systems and one that will meet many of the most urgent farm problems in the corn belt.

THE SOURCES OF INCOME.

It is evident that the principal income from this system is to be derived from the sale of hogs. In addition, there will be a calf or two for sale each year. The hay needed for the horses and cows will be cut from the hog pasture shown as field No. 4 in figure 2. This will permit the sale of all the hay cut from field No. 5.

THE LABOR PROBLEM.

One of the most striking features of this system is the way it meets and solves the labor problem. The chief aim has been to grow only those crops that do not compete seriously for labor, to eliminate as much labor as possible at the rush seasons by the harvesting of crops with live stock, and so to distribute the necessary labor throughout the year as to enable a given crew to handle a maximum acreage with the least possible amount of outside labor. How effectively this is accomplished is shown by the accompanying chart (fig. 6), which shows graphically the amount of time available for field work throughout an average season and the amount of work of this character that is required during each month on a 100-acre farm run by this system. Figure 7 shows the additional labor required to take care of 10 brood sows and their litters under this system of management.

The labor on the 100-acre farm, as charted in figure 6, is done by one man and three horses, with a very small amount of outside help. The crops are two 20-acre fields of corn, 20 acres of rye, 20 acres of clover and timothy, and 20 acres of timothy. The labor indicated in figure 6 also includes the growing of two acres of potatoes. By plowing one field for corn in the fall the one man and three horses are able to handle all the spring work within the limits of available time, get the corn in, cultivate it, and produce the crop without assistance. The next operation is that of putting up the hay, and even with the most modern haying machinery some extra labor is needed.

As previously stated under "The system of live-stock management," the hogs are turned in on the rye field (fig. 2, No. 3) about July 15 and allowed to harvest that crop. On account of this the man and his team are practically relieved from field work after the hay is put up until early in September, when one field of corn must be cut and 20 acres of rye sown. The harvesting of the hay will be done by the last of July, and, with the possible exception of a day or two during August in finishing the haying job, there will be no field work to be done from then until the second 10-day period of September, when corn cutting begins. Thus, there are about five weeks when the man and his team would be idle, but this is thrashing time and he can help his neighbors and do the work indicated in figure 6 as extra labor, in order to pay back the labor he would be forced to hire when shredding a part of the 20 acres of corn in field No. 1 of figure 2, this being necessary to provide bedding in the barn. While extra labor to the extent of 16 extra hands and 6 extra teams is shown in figure 6 during the last 10 days of October for

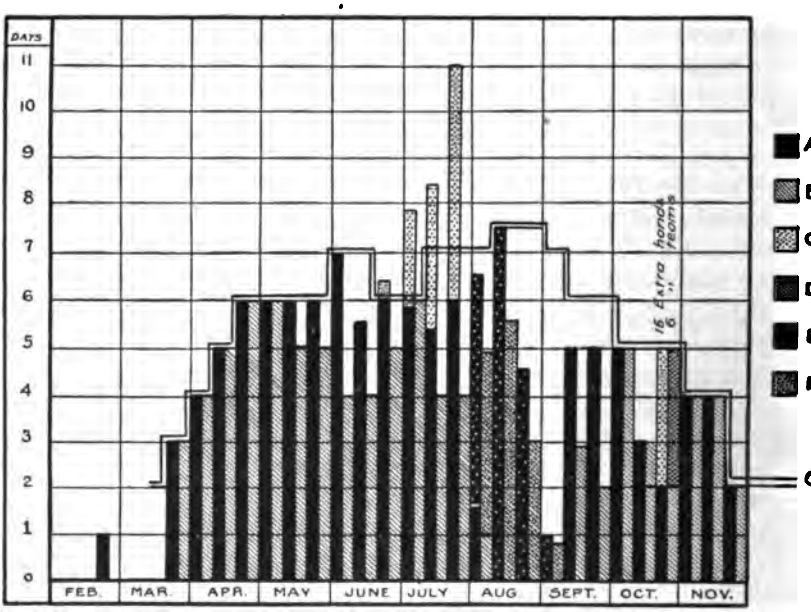

FIG. 6.—Diagram showing the distribution of labor for one man and three horses on a 100-acre corn-belt farm when run on the plan described in this bulletin. Explanation: A—man days, B—3-horse team days, C—extra man labor, D—extra horse labor, E—exchange man labor, F—exchange horse labor, G—available time for one man and three horses.

doing the shredding, this labor is paid for during August and the first 10 days of September by helping these men in thrashing their wheat and oats.

With the extra labor taken care of in this manner there will still remain about 10 days of extra labor during hay harvest that must be paid for in cash. With this small amount of hired help and the assistance of the hogs in harvesting the 20 acres of rye, 20 acres of corn, and the greater part of 20 acres of clover and timothy, one man and three horses can do the work on a 100-acre corn-belt farm.

Figure 7 shows the labor required in the care of 10 sows and their litters during the entire year. This must be done in addition to the regular farm work. A glance at figures 6 and 7 will show how well the labor required by the hogs fits in with the other farm operations and helps fill in the program during slack periods of the regular work. During the winter months there is little work the farmer can do profitably, and it is during this season that the heaviest work is demanded by the hogs. At this time there should be 60 fall pigs, 10 brood sows, and 1 boar to care for, feed, water, slop, bed, etc. The amount of time actually put in at this will vary with the man and the arrangements for handling the hogs. The fall pigs should be divided into two or three lots, according to size. If these are scattered somewhat and the feeding done out of doors, portable shelter houses being used both for the shotes and the sows, more than 4 hours a day will be necessary. If the shotes are allowed to run together in one herd and are housed in a large, permanent house and the sows kept together in a part of the same building, less time

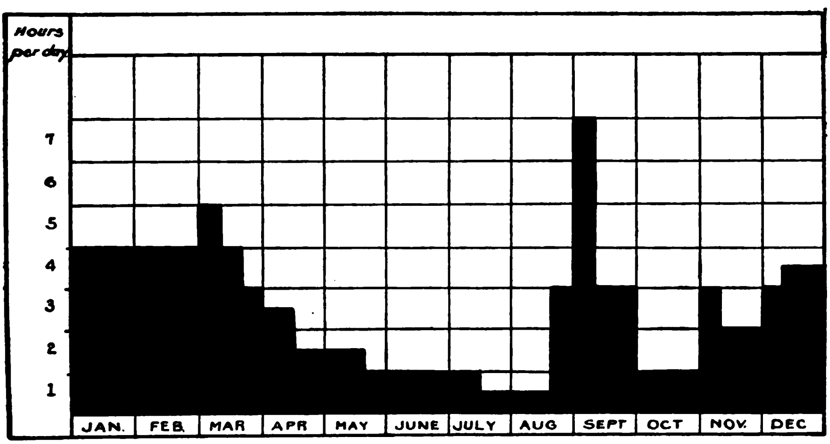

FIG. 7.—Diagram showing the amount and distribution of labor required by 10 brood sows and 120 pigs by the system of management described in this bulletin.

will be required. Under ordinary conditions 4 hours a day will be required for this work throughout the corn belt for the winter months.

The two litters of pigs produced each year are farrowed between March 1 and 15 and September 1 and 15. This accounts for the extra amount of work with the hogs at these two periods. A glance at figure 6 shows that at these periods the farmer has practically no field work to do and can well devote his time to the care of the sows and their young litters, together with whatever attention the shotes may require. From September 1 to 15 there is more work to be done in connection with the hogs than at any other period of the year. During this time the fall litters are farrowed and the shotes are fed corn in order to get them on full feed before turning them into the cornfield which is to be hogged down. For a few days old corn is fed, but gradually new corn takes its place. This is gathered from the field, and still further increases the labor at this time. This constitutes the busiest season of the year for this kind of work, but it comes when there is the least amount of regular farm work to be done.

It will be seen that the hogs are an effective means of cutting down the labor at rush seasons, of avoiding the expense and annoyance of securing much hired labor, and of transferring the bulk of this labor to other seasons of the year, when the farmer can do the work himself. By following a system of this kind the amount of outside or extra labor needed is extremely small. Aside from the saving in money, this independence of outside circumstances is desirable.

SUMMARY.

Labor is the most difficult problem to meet on the average corn-belt farm. This condition is growing worse instead of better and will probably make it necessary to reorganize a large number of farms in that section. Unless systems of farming are adopted that will eliminate a part of the work required at rush seasons, it means cutting down the acreage that each farmer can handle and the net income as well.

By force of necessity many farmers throughout this section have devised such a system and have formulated about the same rotation and general plan of operation. The fact that they can plant and cultivate more crops than they can harvest has led them to resort to gathering much of their crops with live stock and to planting such crops as will lend themselves to this mode of harvesting. The possibilities of saving labor and extending the acreage, and thus increasing the income, by this method are only beginning to be realized.

Swine are a class of live stock admirably suited to solve this particular farm problem. These animals most successfully and profitably harvest the greatest variety of farm crops. Rye, corn, clover, soy beans, rape, and other forage crops that can be grown in the corn belt are harvested thus with a maximum of profit and a minimum of labor to the farmer.

Rye and the hogging off of this crop offer a substitute for wheat, which has become unprofitable on many farms of this section. Under ordinary conditions a price greater than that given for rye on the market is obtained, and all of the rye straw and about 80 per cent of the fertilizing value of the grain are returned immediately to the soil by this process.

The money return per acre from the rye crop, either when hogged off or sold on the market, is not great. When hogged off, this varies with the price of hogs, but will generally be more than if the rye is sold. If the yield of wheat is 20 bushels or more per acre, it is doubtful whether rye should be substituted, but even then the labor situation may force the adoption of rye, together with the hogging-off process.

Corn and clover are most profitably and economically harvested by hogs, and the fertility contained in these crops is thereby returned to the soil with the least possible loss. When these crops are combined with rye and harvested in the same manner, using either a 4, 5, or 6 year rotation, a most efficient farm system for the corn beit is the result. It meets the labor problem, builds up the soil, conserves fertility, and yields a satisfactory income.

The ever-present danger from hog cholera in any system of farming involving swine is fully recognized, but on a number of farms which are using the system here outlined this danger has been successfully obviated by inoculation with hog-cholera serum.

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FARMERS' BULLETIN

615

Contribution from the Bureau of Crop Estimates, Leon M. Estabrook, Chief.
August 22, 1914.

THE AGRICULTURAL OUTLOOK.

CONTENTS.

TIME OF ISSUANCE AND SCOPE OF SEPTEMBER CROP REPORTS.

The report showing the condition of the cotton crop on August 25 will be issued on Monday, August 31, at 12 noon (eastern time).

On Tuesday, September 8, at 2.15 p. m. (eastern time), a crop report will be issued which will give a summary of the condition on September 1 (or at time of harvest) of corn, spring wheat, oats, barley, buckwheat, potatoes, tobacco, flaxseed, rice, and apples, and the yield and quality of hay.

On Wednesday, September 9, a supplemental report will be issued which will show the following: The condition on September 1 (or at time of harvest) of sweet potatoes, tomatoes, cabbages, onions, beans, grapes, pears, millet, kafir corn, cranberries, oranges, lemons, hemp, broom corn, sugar cane, sorghum, sugar beets, hops, and peanuts; production, as compared with a full crop of peaches, watermelons, cantaloupes, alfalfa, and bluegrass; acreage, as compared with last year, and condition of clover for seed; quality of peaches; and number of stock hogs, as compared with last year, and their condition.

GENERAL REVIEW OF CROP CONDITIONS, AUGUST 1, 1914.

The month of July was very unfavorable for crop growth in the United States, the composite condition of all crops on August 1 being 2.0 per cent below their 10-year average, whereas on July 1 prospects were 1.4 per cent above the 10-year average; however, prospects are still 5.0 per cent better than the outturn of last year's crops, which were unusually poor. Improvement occurred during July in nearly all of the Atlantic Coast States, the northern States of Michigan and Wisconsin, and the Mountain States (except Montana and Wyoming). In nearly all other parts of the United States crops deteriorated during July. Poorest crop conditions prevail in Kentucky and sections of

States adjacent to it. The phenomenal wheat crop of Kansas raises the aggregate condition in that State above all others. Winter wheat is the banner crop this year, with tobacco the lowest in condition on August 1.

TABLE 1.—*Estimated yields indicated by the condition of crops on Aug. 1, 1914, and final yields in preceding years, for comparison.*

Crop.	Yield per acre.		Total production in millions of bushels.				Price, Aug. 1.		
			1914 [1]		Final.				
	1914 [1]	1909–1913 average.	August forecast.	July forecast.	1913	1909–1913 average.	1914	1913	1909–1913 average.
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Cts.*
Winter wheat	[2] 19.1	15.6	[2] 675	653	523	441	....	....	....
Spring wheat	13.1	13.3	236	274	240	245	....	....	....
All wheat	17.1	14.7	911	927	763	686	76.5	77.1	91.1
Corn	25.1	25.9	2,634	2,917	2,447	2,708	76.8	65.4	70.6
Oats	30.0	30.6	1,153	1,197	1,122	1,131	36.7	37.6	42.8
Barley	26.9	24.3	203	211	178	182	45.1	50.8	60.6
Rye	[2] 16.8	16.1	[2] 43	....	41	35	61.0	60.7	73.4
Buckwheat	21.5	20.5	17	....	14	17	81.2	72.4	77.9
White potatoes	90.7	97.1	370	361	332	357	87.1	69.2	88.3
Sweet potatoes	84.1	92.7	50	49	59	58	97.5	....	....
Tobacco.....pounds	687.6	815.1	791	757	954	996	....	....	....
Flax	8.7	7.8	17	18	18	20	150.7	118.6	167.9
Rice	33.9	33.3	24	24	26	24	....	....	....
Hay (tame).....tons	1.44	1.34	69	....	64	66	$11.52	$11.16	$11.97

[1] Interpreted from condition reports.
[2] Preliminary estimate.

Details for crops in all States may be found in Tables 12 to 22.

TABLE 2.—*Growing condition of the various crops on Aug. 1, expressed in percentages of their 10-year average (not the normal) on Aug. 1, and the improvement (+) or decline (—) during July.*

Crop.	Condition in percentage of 10-year average, Aug. 1.	Change during July.	Crop.	Condition in percentage of 10-year average, Aug. 1.	Change during July.	Crop.	Condition in percentage of 10-year average, Aug. 1.	Change during July.
Wheat	118.7	− 2.0	Cantaloupes	101.2	+ .2	Tomatoes	93.5	+ 4.2
Apples	113.3	+ 5.2	Millet	100.8	+ .1	Onions	93.4	− 2.0
Lemons	105.4	+ .5	Hops	100.0	− 3.2	Timothy	91.6	+ 2.2
Grapes	104.7	+ 1.2	Broom corn	100.0	− 2.7	Blackberries	91.4	− .4
Raspberries	104.7	+ 4.3	Buckwheat	99.7	....	Sorghum	91.4	− 1.9
Barley	103.9	− 5.8	Pears	99.7	−10.3	Pastures	91.3	− 2.5
Kafir corn	103.8	− 4.1	Flax	99.4	− 4.9	Corn	91.3	−10.0
Sugar beets	103.4	+ .3	Rice	99.1	+ .8	Clover	91.2	+ 6.1
Alfalfa	103.4	− 2.2	Oats	98.1	− 2.9	Lima beans	90.9	....
Hay (all)	103.3	+ 4.6	Peanuts	97.1	+ 3.6	Sweet potatoes	87.3	− 1.0
Peaches	102.9	+ 3.6	Cotton	95.5	− 3.1	Sugar cane	85.3	− 5.9
Oranges	102.2	− 2.4	Cabbages	95.2	+ 1.9	Hemp	82.2	− 5.4
Beans (drying)	101.8	− 1.0	Potatoes	95.1	+ .8	Tobacco	81.6	+ 3.6

TABLE 3.—*Combined condition of all crops on Aug. 1, 1914, by States (100=average), and change during July.*

State.	Condition of all crops, Aug. 1 (100=average).	Change during July.	State.	Condition of all crops, Aug. 1 (100=average).	Change during July.	State.	Condition of all crops, Aug. 1 (100=average).	Change during July.
Maine	109.1	+ 6.8	Ohio	96.1	− 3.3	Texas	89.3	− 7.2
New Hampshire	113.9	+ 8.2	Indiana	86.9	−10.7	Oklahoma	93.3	− 8.7
Vermont	98.4	+ 8.3	Illinois	83.9	−12.5	Arkansas	83.5	− 8.0
Massachusetts	108.3	+11.3	Michigan	109.3	+ 2.6	Montana	96.1	− 6.2
Rhode Island	95.8	+ 2.5	Wisconsin	107.3	+ .2	Wyoming	98.9	− 5.6
Connecticut	103.5	+ 7.2	Minnesota	94.4	− 9.9	Colorado	112.2	+ 2.4
New York	103.4	+ 4.0	Iowa	104.7	− 5.5	New Mexico	113.0	+ 3.3
New Jersey	104.1	+10.5	Missouri	89.0	− 4.5	Arizona	101.0	+ 2.6
Pennsylvania	104.9	+ 6.6	North Dakota	107.4	− 2.8	Utah	105.2	+ .6
Delaware	105.2	+ 9.0	South Dakota	94.0	−18.8	Nevada	104.8	+ 1.7
Maryland	111.8	+12.0	Nebraska	105.6	−10.2	Idaho	100.1	+ .4
Virginia	92.7	+ 6.9	Kansas	122.9	+ 5.7	Washington	103.2	+ .3
West Virginia	85.1	− 1.9	Kentucky	79.3	− 8.9	Oregon	100.6	− 3.4
North Carolina	99.6	+ 3.7	Tennessee	84.1	− 6.8	California	108.4	− 1.6
South Carolina	96.7	− 2.8	Alabama	94.3	− 6.6			
Georgia	98.2	+ .2	Mississippi	95.7	− 2.5	United States	98.0	− 3.4
Florida	98.3	+ 4.8	Louisiana	92.3	− 7.5			

The progress of crops during July and their condition on August 1 in the different States are indicated by the following comments from agents of the Bureau of Crop Estimates:

New England States.—Rains during July materially improved crop conditions, which are generally above their average, except that the hay crop in Vermont and Rhode Island will be light, the result of an unfavorable spring.

New York.—Nearly all crops are doing well. Timely rains during July helped the hay crop to some extent, but later interfered in many sections in harvesting. The drought last year cut short clover and new seeding, but old timothy meadows show well. Mixed grasses are short and thin. Alfalfa is doing well in many sections. Army worms and grasshoppers have been bad in some sections, doing some damage to oats, rye, buckwheat, corn, and hay. Apples will be a large crop. In many places the trees were so heavily loaded that thinning was resorted to, so that the trees will give larger and better fruit. Peaches will be a small crop.

Pennsylvania and New Jersey.—July was very favorable to the growth of all crops. The rainfall was above the average in all parts of the area, with the exception of the extreme southwestern part of Pennsylvania. The army worm has been widespread, but so far seems to have done very little damage. The corn outlook is fine. Oats have improved and the outlook now is for nearly an average crop. Tobacco has made a wonderful growth and, with favorable conditions from now on, the crop will be the best in several years. Apples and peaches are looking good; the berry crop was shortened somewhat by the dry weather in June. Vegetables have all improved during the month and on the whole all crops are above the average.

Maryland and Delaware.—The weather has been ideal for thrashing grain; the yields are generally up to high expectations and quality fine. Drought was broken on July 28, and since then all crops have materially improved and give indications of very good yields.

Virginia.—In the first half of July weather conditions were more or less favorable in most of the State, frequent showers aided vegetation, and on the whole there was improvement, especially in corn, truck crops, grasses, and tobacco. The latter part of the month was unfavorable, the weather being dry, except in widely scattered localities, and exceedingly hot, except in the last few days. Tobacco shows considerable improvement, though stands are not full and fields are irregular. Most growing crops will fall short of an average yield. Corn, a large proportion of which is late, will give a moderate yield if weather conditions henceforth are favorable. Apples and peaches will yield more heavily than usual. Irish potatoes are in poor condition, but sweet potatoes are reasonably promising. The army worm damaged corn and grasses in a few localities.

West Virginia.—A prolonged drought was broken in the latter part of July, benefiting growing crops, although conditions were lower on August 1 than on July 1. Wheat was thrashed under exceptionally high conditions. A large apple crop is expected.

North Carolina.—The month as a whole witnessed some improvement, although crops deteriorated toward the close of the month. Cotton, in most sections, advanced, and a fair yield is indicated from the early crop, but the late is not promising. Tobacco improved considerably, though the stand is short and irregular. Corn is in fairly good condition, in spite of deterioration during the last part of the month, and the early planted will give a reasonable yield. Peaches and apples promise larger yields than usual. Irish potatoes are not in good condition, but sweet potatoes are more promising. Corn and grasses were injured in a few sections by the army worm.

South Carolina.—The latter part of the month was extremely dry, and was very hot over the entire State (except in the last days), which caused deterioration. Cotton, as a whole, is in moderately good condition; in some sections it is somewhat better than usual at this time of year, but in others, drought-stricken regions, it is not good; the late crop does not promise well. Corn has suffered, and largely lost the improvement made earlier, because of heat and drought; favorable weather from now on will result in only a fair yield. The spotted, irregular, tobacco crop is in improved condition as compared with July 1, and promises a better yield than then expected. Truck crops are in moderately fair condition, but not up to the average. Melons were exceptionally good and plentiful. The Irish potato crop is poor, but sweet potatoes are promising. Some damage was caused to grasses and corn in a few localities by the army worm.

Georgia.—Although crop conditions improved slightly during July, the general average on August 1 was moderately below the 10-year average. Cotton is better than average, but corn and most other field crops are materially below. The peach crop is good.

Florida.—The severe drought of the spring damaged the crop and trees of oranges and grapefruit to a considerable extent. They are recovering rapidly from these conditions throughout the greater portion of the State, due to the rather equitable rainfall since about the 1st of June. The crop will be equal to about the average of the last three years, but below the March expectations. The average crop condition per acre is below the normal, but the total production will be increased by new plantings coming into bearing. The corn crop will probably not be larger than the average of the last three years, and quite below the April expectation. More preparation has been made for the hay crop than ever before; the indications are that the September and October yields will be above average. Cowpeas, beggar weed, and velvet beans, as a whole for the State, promise large crops, but somewhat late.

Ohio.—During July, crop conditions in general declined, due principally to the drought and excessive heat which have prevailed throughout this section. Weather conditions were for the ideal harvesting of wheat, and yield and quantity are up to expectations. Corn is badly in need of rain, and considerable damage by the army worm is being reported from the northeastern section of the State. Oats in this section are also being damaged slightly by the army worm. Pastures are drying up, and yield of hay is small, though the quality is excellent. Small vegetables are showing the lack of moisture.

Indiana.—Excessive heat and little or no rainfall, prevalent during earlier months, continued through July, causing marked decline in condition of growing crops. The wheat harvest progressed rapidly, a good yield of excellent quality resulting. Apples were generally hurt by late frosts, and the scale has done much injury.

Illinois.—A deficiency of rainfall and an excess of heat have prevailed over the whole State since April 1, but were most severe in the southern half. This has resulted in a marked deterioration of all the crops except wheat and rye, which were practically made on July 1. The southern and southwestern sections of the State were injured some by drought prior to July, and the Hessian fly did much damage to wheat. Its yield, while good, is not quite up to earlier expectations. In the southwestern part of the State chinch bugs and army worms have added to the injury done by drought to the corn. The condition of oats has changed little during the month, but rust is prevalent. A moderate crop of only fair quality will be harvested.

Meadows and pastures generally have been burned up, and the yield of hay will be small.

Michigan.—Harvesting conditions were unusually favorable. Yields of wheat and rye are generally in excess of those anticipated, except in a few southern counties, where the wheat was badly damaged by the Hessian fly. Corn in parts of the southern districts is curling and in occasional localities drying up. The dry weather caused some dropping of peaches and apples, but the fruit prospects in general continue favorable. The army worm made its appearance at points in the southeastern quarter of the State; its ravages were mostly confined to oats, although in a few instances corn and sugar beets were attacked. Crop prospects in general improved moderately in July.

Wisconsin.—General rains have maintained very favorable crop prospects. Excessively hot weather following early July has caused red rust on the oats in every part of the State. Tame hay on uplands is making the best yields that have ever been seen by old residents.

Minnesota.—Excessive moisture and red rust in June, together with very hot weather the latter part of July, caused the development of black rust on wheat in every part of the State; this, with scald and blight, has greatly reduced the prospective yield. The same conditions also blighted the oats, and, with red rust very heavy, this crop will be light and yield reduced. Barley was little affected by the rust, although some by scald, but on the whole gives promise of an average crop. Winter wheat and rye show fair yields, with a plump berry and the quality above the average. Tame hay has been a bumper crop, with the quality up to standard. Wild hay also was heavy, but the lowland acreage was reduced on account of being too wet. The weather, which was adverse to the small grains, was beneficial to corn, which has made an excellent growth during the month. The major portion is out of danger, unless there is an early frost. There is some stem rot in a small area of the potato district, but on the whole the crop prospects are good.

Iowa.—No general rain storm passed over the State of Iowa in July during the critical time of the corn crop (the tasseling period). Thus corn suffered in some sections at the blossoming period, the critical time, when corn must have a "root-soaker" to mature a full crop. Hessian fly in wheat and dry weather at filling period, account for some disappointing yields of wheat in Iowa. Rust also accounts for low yield of spring wheat. Heavy rains, when oats were in the "boot," followed by hot dry weather, caused oats to head too rapidly and as a result early oats made too much straw and the premature filling of the heads developed light oats. Rust also cut the yield of oats. Excessive heat and destructive rain and wind storms account for the low condition of garden truck.

North Dakota.—Weather conditions have been favorable for rust development and black rust is more or less general in central and southeastern sections, lowering vitality of grain materially, and causing it to be easily blown down. However, a large percentage of the crop was sufficiently advanced to escape serious injury. Late crops, especially late blue-stem wheat, will be seriously affected, and the stand of late oats and barley is poor. The damage existing is due largely to excessive heat and hot winds, which have ripened grain prematurely, bringing on an early harvest following a late seeding. These conditions have caused considerable blight generally, especially in rust localities, with shrunken or inferior quality of grain. Yields will be disappointing. Late rains will be beneficial to corn, flax, pastures, and gardens. There is some wilt damage in flax. The month closed with the crop outlook for the State as a whole reduced from the exceedingly productive prospect of last month.

South Dakota.—Weather conditions have been highly favorable for development of rust, and black rust is general over the State. Early fields, especially of barley and oats, were too far advanced to be seriously damaged, but late fields, especially of blue-stem and velvet-chaff wheat, show severe rust damage, being either directly injured or lowered in vitality, causing grain to be easily lodged by winds. Rusted plants were readily affected by extreme heat and several days of hot winds caused blight conditions to be general, rapidly reducing the heavy prospective yields of last month from 20 to 50 per cent. Drought damage is most evident in the extreme southern part of State, also southwestern sections; but conditions improve toward the northern part of State. Rainfall has been decidedly below normal and of a showery, uneven nature. A result of heat and rust was premature ripening, with grain showing a tendency to be rather light in weight and of a shrunken quality, as well as materially reduced yields.

Nebraska.—Drought prevailed in northeast, northwest, and southeast Nebraska during the month of July, materially cutting the corn crop in those sections. Lack of rain during the tasseling period cut the crop in above-mentioned sections. The winter wheat yield was not quite up to expectations, due to h avy rains during the flowering period (whipping the pollen from the wheat head) and as a result, while the heads are large, many have little wheat on them. Rust did a little damage. Oats are a good crop, with the exception of here and there some fields lodged on heavy soils and some rust in late-variety oats; otherwise the crop is one of the best in years. The alfalfa third crop is light, due to lack of moisture just after the second cutting. A low yield of apples is due to the heavy crop of 1913, accompanied by severe drought while trees were in heavy bearing. Potatoes have a low condition on account of too much growth in vines, so that the vitality did not extend to the tubers.

Kansas.—The most striking feature of the 1914 crop season is the phenomenal yield of wheat in Kansas, being more than twice the average production. The oat crop is made and is a large crop, although not fully up to the early expectations of some persons. The condition of corn on August 1 was slightly above the 10-year average, but it was deteriorating rapidly, owing to hot dry weather; much of the crop was firing and, unless a good rain falls in early August, another poor crop will probably be the result. Grass crops are above average, but potatoes are below.

Kentucky.—This State, of all the States of the Union, shows the lowest condition of crops on August 1, the low condition on July 1 having been lowered much further by high temperature and the continuation of drought. The wheat crop yielded well, not having been adversely affected by the drought; tree fruits also are slightly above their average; but practically all other crops are threatened with failure or very low yields.

Tennessee.—Conditions are almost the same as in Kentucky, but probably somewhat less acute. Although the cotton has suffered for lack of moisture and has been greatly damaged, it shows a healthy condition, is well fruited and highly cultivated. Army worms have appeared in some localities in east Tennessee and prompt measures have been adopted for their destruction.

Alabama.—Taking Alabama as a whole, all crops showed deterioration during July, cotton least, old corn most, but all crops fell below the standard on July 1. Some complaint of wilt, or blackroot, is heard in southeast Alabama. Good soaking rains would save the late corn, prevent premature opening of cotton in the dry belts, and, if not too frequent, would produce record cotton crops in many counties of the State. Damage from boll weevils has not reached expectations, due to dry weather. Wheat and oats came off ahead of the drought, and the yield was excellent.

Mississippi.—The cotton crop of Mississippi made fair progress in July. Cotton showers in many sections, and the checking of boll weevil ravages in others, will offset the loss from the prolonged drought in certain other sections. All cotton, whether large or small, is better fruited, size considered, than ever known. Corn depreciated all over the State. Much of the old corn is an entire failure. Sugar cane, sweet potatoes, peas, and all truck crops, likewise, suffered from the drought and excessive heat. These influences, however, pretty nearly destroyed the boll weevils, and with sufficient, but not excessive and too frequent, rains during August, all crops except old corn will respond, and promise a good yield.

Louisiana.—Protracted drought and high temperatures throughout northern Louisiana have caused serious damage to all crops. The boll weevil and army worm are very active in many sections. In the far southerly parishes very heavy rains occurred from time to time throughout the month, followed by exceedingly hot spells, and much damage was done to growing crops by the rain and the wind which accompanied it. Cane has been somewhat behind, but is now displaying an encouraging tendency to catch up, and will do so if the rains will cease for a while. Cotton has received a serious setback due to the dry weather and the ravages of the boll weevil and the army worm. Early corn has been seriously burned by the dry, scorching weather in the northern parishes, but the late corn is fairly promising. Rice is heading nicely in the river districts, and harvesting is expected to commence about August 15. The indications are good for a full yield throughout the State. Truck generally is not in good condition.

Texas.—July was lacking in moisture under prolonged conditions of high temperatures, causing injury to nearly all crops. The first of July found everything late or suffering from effects of the continuous excessive rains of the month of May. June had proven abnormally dry and hot, and the deficiency of surface moisture was reflected, first, in the corn crop, which was about one month late. Winter wheat and oats at the harvest were short in expected yields and light in tests, resultant upon washings of the pollens during the rainy period. As the month advanced, light, scattering showers prevailed over a great portion of the State for a few days during the second week, but were not beneficial. Corn began to suffer in the north, east, and central parts of the State for want of rain at the flowering period. Temperatures were high, and the crop was greatly injured. At the close of the month, the rainfall showed an average of less than an inch for July.

Oklahoma.—The extreme heat and dry weather during the month of July have reduced the general crop conditions for the State. Rainfall was extremely local and over widely-scattered areas during the early part of the month, while the latter part of the month was dry and intensely hot. The third cutting of alfalfa is materially reduced. Pastures are drying, water scarce, and prairie hay not as good as in former years on account of weeds.

Arkansas.—All crops all over the State were needing rain on July 1, and rain fell practically generally from the 1st to the 8th. In the northern part, where on account of altitude and soil conditions, and in southern and southwestern parts, where on account of the advanced stage of crops conditions were most threatening, the rain did not benefit corn as it usually would have done. Forage crops and pastures and meadows suffered considerably during the month, and much was practically ruined before rains fell. The last part of the month was dry. No complaint of insect pests was made except in scattered localities, where boll weevil has affected cotton. Lowland crops are generally good, and cotton fruiting well. The month would have been favorable had not the long drought preceded it. The outlook August 1 was much improved.

Montana.—Conditions in different parts of the State are variable, but as a whole prospects are for somewhat less than an average crop of small grain, but a good average for most vegetables. Hay prospects are good.

Wyoming.—Conditions declined some in July, but are nearly average. In the irrigated districts conditions are good; in the nonirrigated districts grain yields were reduced by dry, hot weather. Alfalfa and other hay yielded well and have been harvested in good condition. The apple prospects are excellent.

Colorado.—Crop prospects are very good, well above the average. The supply of water for irrigation purposes continues to be ample for all sections, the snow melting in the mountains affording the main supply in addition to the supply from frequent heavy rains in the foothills. Most of the reservoirs are filled.

New Mexico.—General crop conditions August 1 were much better than at any time during the season, having greatly improved over the very satisfactory conditions of July 1. Unusually favorable moisture conditions have prevailed during the entire season. The stock ranges are in excellent condition and an abundance of winter feed on the range is assured. The acreage of native grasses cut for hay will be unusually large. Not for many years have the crops in this State been in such fine order.

Arizona.—The acreage of cotton has been increased from 4,000 acres last year to 18,000 acres this year. Fruit prospects are about the same as last month, though above their 10-year average condition on August 1. The bulk of the melon shipments were made during July and the yield was extra good. Stock ranges are in good condition and the outlook for range pasture is very satisfactory.

Utah.—The trend of crop conditions in Utah during the month of July has been practically normal. Forage crops, with the exception of alfalfa, are in prime condition. Mountain pastures are particularly rich for the season. Although the stand is thin in spots, owing to lack of rain 30 days after the seeding period, sugar beets have made a remarkably strong and healthy growth.

Nevada.—All crops have made normal progress during July. Heavy winter snowfall and abundance of spring rain produced mountain pasture conditions above the average, and the grass has been cured perfectly during a dry July. Abundance of forage for the winter is assured.

Idaho.—The yield of winter wheat will be nearly average and the spring grains are looking very well. Corn and potatoes were injured by the June frosts, but they have apparently recovered and give good promise. Most of the corn and potatoes are grown under irrigation, and the supply of water for that purpose is fairly good. All other crops are doing well.

Washington.—About normal conditions prevailed during July and crops as a whole are somewhat above average. Open winter without damaging frosts and opportune rains favored all grain and hay. Fruits and vegetables were affected by late frosts in April and May. Apple prospects are very good. Hops suffered from dry weather in the western part of the State, but are good in Yakima.

Oregon.—Aggregate crop conditions are slightly above average, although prospects were lowered during July. Winter wheat was damaged some by smut; the excessive temperatures in July tended to slightly shrivel the grain (kernel), which naturally somewhat reduced the yield, although millers say this slight shriveling tends to improve the milling quality. The hay crop for the entire State is heavy. April rains gave the crop a good start and the quality is good. Considerable clover, originally intended for the seed crop, has been turned into hay on account of insect ravages. As a result of the abundant crop, the price is not attractive to the grower. Potatoes planted very early have made normal growth, but late-planted areas are suffering from dry weather. Hop men claim that the shortage of rainfall will materially reduce early high estimates of total production. One of the best-informed dealers states that in his opinion the Oregon crop will amount to not more than 120,000 bales, whereas a month ago the estimate was for 150,000 bales. The yards are reported free from vermin and the quality of the crop is expected to be above normal.

California.—The relative condition of crops on August 1 is indicated by the following figures, 100 representing an average condition on August 1 of recent years (not normal): Almonds, 119; peaches, 118; barley, 116; hay, 113; apples, oats, and kafir corn, 109; apricots, 108; corn, beans, and lemons, 106; olives, 105; potatoes, 103; grapes, 102; oranges, 101; sugar beets, 100; walnuts, 99; hops, 97; prunes, 95.

OUTLOOK FOR THE 1914 FOREIGN WHEAT CROP.

By Charles M. Daugherty

The general tone of foreign crop reports during the past month has indicated previous estimates of prospective yields to be too optimistic. Both in Canada and in most countries of Europe prospects have declined and total yields are recognized to be much inferior to those of a year ago. On August 1 harvest in Europe had in its northward progress reached the north-central latitudes of the great wheat belt, and considerably over half the European crop was either thrashed or stacked. Current estimates, therefore, relate, on the one hand, to grain actually reaped and, on the other, to growing crops to be harvested in August and September.

In most countries where cutting has been finished—notably in Italy, southern France, Hungary, Roumania, the Balkan States, and south Russia—harvesting operations were interrupted by frequent torrential rains; prospective yields were thereby somewhat reduced and the quality of much grain impaired.

The Italian and Hungarian Governments have reduced previous forecasts of production each by upward of 7 million bushels; the former now puts its crop at 172,694,000 bushels, against 180,042,000 a month ago; and the latter at 125,400,000 bushels, as compared with an estimate in early July of 133,916,000. The outturn of these countries last year was, respectively, 214,405,000 and 151,346,000 bushels.

The Spanish crop, according to the recent official preliminary figures, is 120,313,000 bushels; although almost 8 million bushels larger than that of 1913, the yield is still 10 million bushels below the average of the past five years. In the southern half of France, the wet harvest has impaired the quality of a crop that was already acknowledged to be of very moderate proportions.

Roumanian yields, which up to harvest were generally believed to approximate the 80 million bushel total of last year, are unofficially reported disappointing, both as to quantity and quality, and to promise little more than 80 per cent of the original expectation. Meager unofficial returns from Bulgaria and Servia also indicate results not at all satisfactory.

In European Russia the Central Statistical Committee, with the appearance of the plants on July 1 as a basis, has forecast a prospective harvest of spring wheat in the 63 governments at 390,388,000 bushels and of the winter variety at 297,044,000—a total of 687,432,000 bushels. As the corresponding yields of the two varieties last year, as finally returned, were, respectively, 542,294,000 and 295,453,000 bushels—a total of 837,747,000 bushels—the July 1 prospect was that the volume of the 1914 crop would be inferior to the banner yield of 1913 by 150,315,000 bushels, the shortage being entirely in spring wheat. No later forecast has been issued, but it is generally believed that meteorological conditions since July 1—torrential rains during winter-wheat harvest in the south and prolonged drought in spring-wheat regions—have considerably diminished the prospect presented in midsummer.

In those latitudes of Europe where wheat is yet to be harvested the plants during July generally made seasonable development. On August 1 former prospects of yields were, for the most part, fully maintained. In the United Kingdom the promise is officially described as for a slightly better than average crop, and in the more northerly latitudes of continental Europe meteorological conditions have been generally favorable to the maintenance or even to the improvement of the moderate prospects of a month ago. The disturbed political conditions, however, are enforcing, in the midst of harvest, widespread abandonment of the fields by the male population of military age, and the saving of standing wheat and other unharvested crops promises to devolve largely upon female and youthful labor. Although the stress of urgent necessity will be a powerful influence against permitting waste, the effect of these unusual harvest conditions upon ultimate yields is for the present problematical.

COTTON CONDITION, JULY 25, 1914, WITH COMPARISONS.

The Crop Reporting Board of the Bureau of Crop Estimates estimates, from the reports of the correspondents and agents of the Bureau, that the condition of the cotton crop on July 25 was 76.4 per cent of a normal, as compared with 79.6 on June 25, 1914, 79.6 on July 25, 1913, 76.5 on July 25, 1912, and 80.0, the average on July 25 of the past 10 years.

TABLE 4.—*Comparisons of conditions of cotton by States.*

State.	July 25, 1914.	June 25, 1914.	July 25—		
			1913	1912	10-year average.
Virginia	89	86	81	85	82
North Carolina	86	82	77	80	80
South Carolina	79	81	75	75	79
Georgia	82	83	76	68	80
Florida	86	86	82	75	83
Alabama	81	88	79	73	79
Mississippi	79	81	77	68	77
Louisiana	76	81	79	76	77
Texas	71	74	81	84	81
Arkansas	72	80	87	74	81
Tennessee	73	79	90	71	83
Missouri	75	93	86	75	84
Oklahoma	75	79	81	80	82
California	100	100	100	99	....
United States	76.4	79.6	79.6	76.5	80.0

TABLE 5.—*Condition of cotton, monthly, and estimated yield per acre for the past 10 years.*

Year.	May 25.	June 25.	July 25.	Aug. 25.	Sept. 25.	Yield per acre.
						Lbs. lint.
1913	79.1	81.8	79.6	68.2	64.1	182.0
1912	78.9	80.4	76.5	74.8	69.6	190.9
1911	87.8	88.2	89.1	73.2	71.1	207.7
1910	82.0	80.7	75.5	72.1	65.9	170.7
1909	81.1	74.6	71.9	63.7	58.5	154.3
1908	79.7	81.2	83.0	76.1	69.7	194.9
1907	70.5	72.0	75.0	72.7	67.7	178.3
1906	84.6	83.3	82.9	77.3	71.6	202.5
1905	77.2	77.0	74.9	72.1	71.2	186.1
1904	83.0	88.0	91.6	84.1	75.8	204.9
Average 1904-1913	80.4	80.7	80.0	73.4	68.5	187.2

APPLE-CROP FORECAST.

Forecast of a production of 210,000,000 bushels of apples is made from reports of the condition of the crop on August 1, which indicated 61.3 per cent of a normal, compared with 54.3, the average of the past 10 years. The estimate of production last year is 145,000,000 bushels, two years ago 235,000,000 bushels, three years ago 214,000,000, four years ago 142,000,000; and five years ago, the Census report indicates a production of 146,000,000. On page 32 is given a table showing, by States, the forecast this year, the estimated production yearly for 1910 to 1913, inclusive, and the mean price to producers in the three months of heavy marketing, September, October, and November. Below is given for the United States and important apple States the Census reports of production in 1899 and 1909, the forecast for 1914, and estimate of production in intervening years.

Apples: Production 1899–1914 in United States and important States; 1899 and 1909 Census figures; 1914 figures, forecasts from condition reports August 1; other years, estimates made from percentages applied to Census basis.

[Bushels, 000 omitted.]

Year.	United States.	Maine.	New York.	Pennsylvania.	Virginia.	West Virginia.	Ohio.	Michigan.	Illinois.	Missouri.	Arkansas.	Washington.	California.
1899....	175,398	1,422	24,111	24,061	9,836	7,496	20,617	8,932	9,178	6,496	2,811	729	3,488
1900....	205,930	5,000	47,000	18,000	8,500	4,200	13,800	11,800	7,500	8,300	2,900	1,950	3,200
1901....	135,500	2,550	11,000	9,000	9,500	6,100	10,500	5,200	5,900	10,500	3,300	1,870	4,000
1902....	212,330	3,780	41,000	19,000	6,700	4,300	12,700	18,000	10,100	11,700	4,000	2,300	4,200
1903....	195 680	4,170	46,000	18,500	13,100	3,800	13,500	15,400	5,100	6,200	2,400	2,600	4,100
1904....	233,630	5,600	55,000	25,000	6,000	6,500	14,000	18,700	6,000	9,700	4,000	2,700	3,900
1905....	136,220	2,800	21,000	13,500	10,100	4,800	4,800	6,300	4,500	6,300	3,200	2,500	3,800
1906....	216,720	3,800	31,000	17,500	5,500	5,900	16,000	13,700	12,100	20,000	4,300	3,000	4,600
1907....	119,560	4,950	28,000	13,800	5,200	2,700	4,000	9,500	1,600	1,300	3,600	3,800	4,000
1908....	148,940	1,800	33,000	14,800	8,900	5,300	6,000	7,000	2,600	6,100	1,600	3,200	4,800
1909....	146,122	3,636	25,409	11,048	6,104	4,225	4,664	12,332	3,093	9,969	2,296	2,672	4,931
1910....	141,640	3,550	17,000	11,600	12,100	7,100	5,900	4,200	800	7,600	2,700	5,800	4,600
1911....	214,020	6,800	39,000	20,500	7,200	7,800	18,700	12,300	10,600	11,600	3,000	3,500	4,700
1912....	235,220	5,400	44,000	12,700	15,000	10,300	10,600	17,200	5,800	19,200	5,100	7,700	5,700
1913....	145,410	3,000	19,500	10,200	5,200	1,000	4,800	8,000	8,200	7,900	4,000	6,900	3,000
1914....	210,300	5,500	36,000	19,500	12,300	10,300	10,500	13,100	4,100	11,700	4,000	7,000	5,300

PERCENTAGE OF APPLE SHIPMENTS IN CARLOAD LOTS.

The proportion of carloads to smaller lots in consignments of apples was the subject of an inquiry made last month (July, 1914) by the Bureau of Crop Estimates. A circular letter was sent to wholesale merchants in 13 large cities, including Boston and San Francisco, and 120 replies were received. These reports covered 1,531,000 barrels of apples, of which 81 per cent arrived at the cities in carload lots and 19 per cent in smaller consignments.

DURUM-WHEAT EXPORTS.

According to reports made to the Bureau of Crop Estimates, 11,785,000 bushels of durum wheat were exported from the United States during the year ending June 30, 1914, a decrease of about 3,700,000 bushels compared with 1913, and the receipts of durum wheat at five leading primary markets amounted to 20,625,000 bushels, or about 2,000,000 less than in 1913. Durum formed 16.4 per cent of all wheat received at those markets in the fiscal year ending June 30, 1910, 11.1 in 1911, 3 in 1912, 7.2 in 1913, 7.9 per cent in 1914, and this variety formed 39.3 per cent of all wheat (excluding flour) exported from the United States in 1910, 13.8 in 1911, 6.1 in 1912, 16.9 in 1913, and 12.8 per cent in 1914.

Quotations at Minneapolis show the prices per bushel of Nos. 1 and 2 durum wheat were from 1 to 4 cents higher than the same grades of Northern wheat for September, 1912, and from January to May, 1913. For June and July, 1913, the prices of Nos. 1 and 2 grades of both varieties were the same. From October to December, 1912, and from August, 1913, to July, 1914, the price per bushel of Nos. 1 and 2 grades of Northern wheat ranged from 1 to 4 cents higher than the corresponding grades of durum.

TABLE 6.—*Durum wheat: Exports from the United States and receipts at five leading primary markets, during the years ending June 30, 1910–1914.*

[From reports made to the Bureau of Crop Estimates.]

Item.	Year ending June 30—				
	1910	1911	1912	1913	1914
Exported from:	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Baltimore	948,000	150,000	8,000	382,000	389,000
Boston	540,000	362,000	46,000	....	318,000
Duluth, via Canada	5,613,000	2,481,000	45,000	1,216,000	2,448,000
Galveston	72,000	....	....	....	....
New Orleans	27,000	....	....	....	....
New York	7,725,000	158,000	1,569,000	11,215,000	6,920,000
Philadelphia	2,575,000	123,000	184,000	2,141,000	1,568,000
Portland, Me	845,000	....	....	507,000	142,000
Total	18,345,000	3,274,000	1,852,000	15,461,000	11,785,000
Received at:					
Chicago	[1] 833,000	1,151,000	472,000	472,000	673,000
Duluth	21,927,000	6,807,000	3,074,000	14,419,000	14,215,000
Minneapolis	11,194,000	11,232,000	2,157,000	6,590,000	4,720,000
Omaha	[2] 256,000	[2] 242,000	75,000	[2] 207,000	[2] 379,000
St. Louis	[2] 552,000	[2] 332,000	52,000	851,000	638,000
Total, 5 cities	34,762,000	19,764,000	5,830,000	22,539,000	20,625,000

[1] Six months, July-December, 1909.
[2] Estimated from reported number of carloads by assuming an average of 1,200 bushels per car.

SUGAR-BEET FORECAST.

The condition of sugar beets August 1 was 92.4 per cent of a normal. This forecasts a yield per acre of about 10.3 tons. The actual outturn will likely be above or below this amount, according as conditions to harvest are better or worse than usual. A yield of 10.3 tons on the estimated planted acreage, 520,600 acres, amounts to 5,362,000 tons; but there is usually some abandonment, the average in recent years being 10 per cent. Assuming an average abandonment of 10 per cent, there would result about 4,826,000 tons of sugar beets. The production in 1913 was 5,659,000 tons; in 1912, 5,224,000; in 1911, 5,062,000; and in 1910, 4,047,000 tons.

CLOVER SEED IN OREGON.

Within recent years the growing of clover for seed has become quite an important industry in western Oregon. The 1913 seed crop was probably in excess of 2,000,000 pounds, and the greatly increased acreage in 1914 would normally have largely increased the total production for 1914. But there has been a great amount of damage from the clover midge, working in the head, and the clover root borer, affecting the crown of the plant. A very considerable portion of the crop intended for seed will not be worth harvesting for that purpose, and as it has been allowed to get beyond the proper stage of ripeness for hay, will have very little value for that purpose.

The damage is not at all uniform. Where some fields are practically ruined, only a few miles away the fields generally appear to be in good condition. Quite a little hulling has already been done, and yields of six and seven bushels of red clover seed per acre have been obtained. The alsike variety seem to yield even better than the red. In Linn County, which is probably the heaviest clover seed producing county in the State, dealers estimate that, notwithstanding the increased acreage, the production will probably be not more than one-half that of last year.

TREND OF PRICES OF FARM PRODUCTS.

The level of prices paid producers of the United States for the principal crops decreased about 0.1 per cent during July; in the past 6 years the price level has decreased during July 0.1 per cent.

On August 1 the index figure of crop prices was about 9.7 per cent higher than a year ago, but 7.0 per cent lower than 2 years ago and 1.3 per cent lower than the average of the past 6 years on August 1.

The level of prices paid to producers of the United States for meat animals increased 2.6 per cent during the month from June 15 to July 15, which compares with an increase of 0.9 per cent in the same period a year ago, an increase of 1.0 per cent 2 years ago, an increase of 1.4 per cent 3 years ago, and a decrease of 4.2 per cent 4 years ago.

From December 15 to July 15 the advance in prices for meat animals has been 8.2 per cent; whereas during the same period a year ago the advance was 13.0 per cent, and 2 years ago 17.9 per cent, while 3 years ago there was a decline in price of 11.1 per cent during this period.

On July 15 the average (weighted) price of meat animals—hogs, cattle, sheep, and chickens—was \$7.41 per 100 pounds, which compares with \$7.25 a year ago, \$6.33 two years ago, \$5.52 three years ago, and \$6.98 four years ago on July 15.

A tabulation of prices is shown on pages 34 and 35.

SUPPLY OF CATTLE HIDES.

By George K. Holmes.

About one-third of the cattle hides treated in the leather manufacturing industries of this country five years ago were imported from other countries. In the meantime the number of cattle on the farms and ranges of the United States has diminished, the consumption of hides has increased, and a present European war has affected the international trade in hides, so that the industries that tan and otherwise treat cattle hides and use their leather are facing uncertainties in the supply of the raw material.

According to the census report on the leather manufacturing industries, 20,516,332 cattle hides were treated in 1909, of which 13,764,686 were taken off the cattle of this country, leaving approximately one-third of the consumption to be supplied by foreign countries. The cattle slaughter of that year, according to the census report on agriculture and on slaughtering and meat packing, was 13,611,422, but this number did not include an apparent 150,000 cattle that died from accident and disease.

The imports of hides into this country are reported in pounds and not in number of hides, and no fairly good estimate of such number can be made, for the reason that the imported hides are both dried and wet, or salted, with no separation in the report; and furthermore, the hides are derived from many countries, the cattle of which vary in average size, and some buffalo hides are included. In the year ending June 30, 1909, the imported cattle hides weighed 192,252,000 pounds, to use a round number, a quantity that far exceeded the previous record, and in the next year the imports amounted to the remarkably high total of 318,002,000 pounds. Apparently this resulted in an overstocking of the market, because in the following year, 1911, the imports fell to 150,028,000 pounds. For 1910 and 1911 combined, the average yearly imports were 234,015,000 pounds. The import record continued to be broken year by year, and cattle hides weighing 251,013,000 pounds were received in 1912, after which 268,042,000 pounds were received in 1913, and 279,769,000 pounds in 1914.

From 1909 to 1914 the imported cattle hides increased 45.5 per cent in weight, and the number of cattle on farms declined from 61,804,866 in 1910, as ascertained in the census, to 57,592,000 as estimated by the Bureau of Crop Estimates of the Department of Agriculture, a decline of 8.4 per cent. It may be roughly computed from the foregoing figures that the imported cattle hides have reached over two-fifths of the consumption, but less than one-half. The supply from foreign countries, therefore, has been a matter of increasing moment, independent of conditions of war.

As the trade statistics are expressed, the various countries that supply hides to the United States often vary much in importance from year to year. The reason for this is largely a roundabout and indirect transportation in the ships of the United Kingdom, Germany, France, and other countries. According to the record in this country, 25 per cent of the weight of hides imported in 1913 came from Argentina, 15.5 per cent from Canada, 11 per cent from Mexico, 8.5 per cent from European Russia, 7.5 per cent from France, 3.7 per cent from Germany, 3.2 per cent from the United Kingdom, 2.7 per cent each from Uruguay and the Netherlands, 2.6 per cent from Belgium, 2 per cent from Colombia, 1.7 per cent from Venezuela, 1.1 per cent from Cuba, and comparatively insignificant quantities from other countries. The countries mentioned supplied, on the face of the record, about nine-tenths of the imports of cattle hides.

The cattle hides that came from Belgium, France, Germany, European Russia, and the United Kingdom in 1913 were 25.5 per cent of the total imports of hides, and about one-ninth of the consumption. These fractions would be larger if all the cattle-hide imports carried in the ships of the countries mentioned could be stated. (See Table 7 for details of statement of imports of cattle hides from principal countries from 1909 to 1914.)

TABLE 7.—*Imports of cattle hides into the United States, by principal countries from which consigned.*

[From Bureau of Foreign and Domestic Commerce. 000 omitted from pounds of imports.]

Country and period.	Fiscal year ending June 30—						
	1909	1910	1911	1912	1913	1914	Percentage of total in 1913.
All countries:							
July to Dec., calendar year preceding	*Pounds.* 87,862	*Pounds.* 174,655	*Pounds.* 78,620	*Pounds.* 99,142	*Pounds.* 151,659	*Pounds.* 107,182	....
Jan. to June	104,390	143,349	71,508	151,871	116,383	172,587	....
Total fiscal year	192,252	318,004	150,128	251,013	268,042	279,769	100.0
Argentina	49,236	84,158	41,971	83,662	67,042	....	25.0
Belgium	7,823	19,205	3,495	9,073	7,106	....	2.6
Brazil	1,704	2,607	400	714	1,744	....	.7
Canada	31,236	29,824	29,439	29,770	41,608	....	15.5
Colombia	4,380	5,501	5,809	6,304	5,462	....	2.0
Cuba	7,548	6,095	3,752	4,366	2,840	....	1.1
France	14,124	23,266	9,939	15,574	20,102	....	7.5
Germany	3,447	16,672	2,746	7,247	9,787	....	3.7
Italy	3,934	6,066	1,964	4,854	2,412	....	.9
Mexico	18,560	32,789	22,799	28,103	29,500	....	11.0
Netherlands	3,858	9,297	3,462	6,580	7,271	....	2.7
Russia, European	265	6,363	107	9,044	22,906	....	8.5
United Kingdom	9,967	15,091	1,689	9,262	8,589	....	3.2
Uruguay	13,495	27,686	5,290	10,934	7,245	....	2.7
Venezuela	5,806	5,708	4,445	5,556	4,471	....	1.7

Apart from such changes as may be made in the world's supply of cattle hides by the European war, changes in the distribution of that supply may be expected. Statements of the exports and imports of cattle hides from and to principal countries in 1912 may be found in Tables 8 and 9. To the total exports of all countries, Argentina contributed 18.9 per cent in 1912; British India, 9.9 per cent; Germany, 8.7 per cent; Russia, 8.6 per cent; Brazil, 6.2 per cent; France, 6.0 per cent; the Netherlands, 5.0 per cent; Uruguay, 3.7 per cent; China, 3.4 per cent (buffaloes); Austria-Hungary, 3.3 per cent; Italy, 2.7 per cent; Mexico, 2.5 per cent; the United Kingdom, 2.4 per cent.

Some of these countries, however, exported great quantities of cattle hides that they had imported. In the world's import trade in cattle hides in 1912 the share of Germany was 22.5 per cent; the United States, 21.8 per cent; Belgium, 12.9 per cent; France, 8.2 per cent; the United Kingdom, 7.6 per cent; Russia, 5.5 per cent; Austria-Hungary, 5.0 per cent; the Netherlands, 5.0 per cent; Italy, 3.2 per cent.

Upon subtracting the exports of cattle hides from the imports for principal importing countries for 1912, it appears that, while Germany imported a greater quantity of hides than any other country, the United States being next in order, the exports from Germany were so much greater than those from the United States that the net imports of this country far exceed those of Germany and are much more than those of any other prominent importing country. Although Austria-Hungary, Belgium, France, Italy, the Netherlands, and the United Kingdom figure largely in the export trade in cattle hides, in reality they are all countries of deficiency, and their national consumption depends on foreign countries for a large contribution.

In the absence of an increase in the world's supply of cattle hides, it is evident that the supply of the United States from foreign countries, under European war conditions, is subject to diversions and interruptions. A great portion of the imports have come in the ships of other countries, and some of the more prominent of those countries are unable to continue the service. If the United States or other countries supply a substitute service, cattle hides will continue to be imported, presumably at least in usual quantities and as required. Indeed, assuming that war conditions in other countries are reducing the consumption of cattle hides in those countries, at least for reexport in manufactured goods, it follows, in the absence of a diminution in the world's supply of cattle hides, that a large share of the supply may be available to the United States if the means of ocean transportation are sufficient.

TABLE 8.—*Exports of cattle hides from principal countries in 1912.*

[Yearbook of the U. S. Department of Agriculture; 000 omitted.]

Country.	Total.		Dried.	Wet, or salted.
	Quantity.	Per cent of total.		
	Pounds.		*Pounds.*	*Pounds.*
Argentina	242,993	18.9	69,469	173,524
Austria-Hungary	42,846	3.3	8,253	34,593
Brazil	79,927	6.2	16,316	63,611
British India	127,446	9.9		
British South Africa	20,595	1.6		
China (buffalo)	43,920	3.4		
Chosen (Korea)	4,448	.4		
Cuba (1911)	14,248	1.1		
Egypt (1911, including camel)	6,889	.5		
France (large)	77,828	6.0		
Germany	111,671	8.7		
Italy	35,203	2.7		
Mexico	32,635	2.5		
Netherlands	64,649	5.0	21,645	43,004
New Zealand	4,544	.4		
Peru (1911)	4,461	.4		
Russia (large and small hides)	110,614	8.6		
Singapore (1911)	5,111	.4		
Spain (unclassified)	8,202	.6		
Sweden (1911)	28,588	2.2	28,065	523
Switzerland	15,897	1.2		
United Kingdom	30,447	2.4		
United States	20,514	1.6		
Uruguay (1910)	48,045	3.7	18,560	29,485
Venezuela	7,426	.6		
Other countries (including buffalo)	98,510	7.7		
All countries (including buffalo)	1,287,657	100.0		

TABLE 9.—*Imports of cattle hides into principal countries in 1912.*

[Yearbook of the U. S. Department of Agriculture; 000 omitted.]

Country.	Total.		Dried.	Wet, or salted.
	Quantity.	Per cent of total.		
	Pounds.		*Pounds.*	*Pounds.*
Austria-Hungary	72,883	5.0	37,877	35,006
Belgium (wet)	186,116	12.9		186,116
British India	21,174	1.5		
Finland (1911)	7,123	.5	3,186	3,937
France (large)	118,578	8.2		
Germany (including buffalo)	325,167	22.5	88,521	236,646
Greece (unclassified)	5,257	.4		
Italy	46,517	3.2		
Japan	5,674	.4		
Netherlands	72,321	5.0	35,791	36,530
Norway	15,189	1.1	3,475	11,714
Portugal	7,576	.5	7,398	178
Roumania (1911, including buffalo)	8,629	.6		
Russia	79,773	5.5	6,861	72,912
Singapore (1911, unclassified)	7,835	.5		
Sweden (1911)	23,845	1.6	18,511	5,334
United Kingdom (including calf skins)	110,615	7.6		
United States (including buffalo)	314,478	21.8	107,241	207,237
Other countries (including buffalo)	16,892	1.2		
All countries (including buffalo)	1,445,642	100.0		

No increase in the world's supply of cattle hides from increased production would seem now to be indicated, without a slaughter of breeding stock. The herds of the principal surplus countries are about stationary in numbers. While they are gradually increasing in Canada, New Zealand, and Uruguay, a stationary condition or diminishing tendency exists in Argentina, Australia, Cuba, Mexico, Russia, and the United States. Table 10 may be examined for an understanding of the drift of cattle production in principal surplus hide countries and the United States.

TABLE 10.—*Number of cattle in selected countries at a certain date in specified years.*

[Cattle not on farms and ranges included for some countries, uniformly for all years.]

Country and year.	Number of cattle.
ARGENTINA.	
1888	21,961,657
1895	21,701,526
1908	29,116,625
1909	27,824,509
1910	28,827,900
1911	28,786,168
1912	29,016,000
1913	28,500,000
AUSTRALIA.	
1890	10,299,913
1894	12,311,617
1895	11,767,488
1897	10,832,457
1899	9,645,690
1900	8,640,225
1902	7,062,742
1905	8,528,331
1906	9,349,409
1907	10,128,486
1909	11,040,391
1910	11,744,714
1911	11,828,954
1912	11,577,259
BRAZIL.	
Latest and best estimate	30,705,000
CANADA.	
1891	4,120,586
1901	5,372,504
CANADA—contd.	
1911	6,533,436
1912	6,431,861
1913	6,656,121
COLOMBIA.	
1896	3,465,000
1909	4,000,000
CUBA.	
1891	2,455,788
1895	2,485,766
1899	376,650
1906	2,566,870
1910	3,212,087
1912	2,829,553
MEXICO.	
1902	5,142,457
NEW ZEALAND.	
1891	788,919
1896	1,047,901
1897	1,209,165
1901	1,361,784
1902	1,460,663
1903	1,593,547
1904	1,736,850
1905	1,810,936
1906	1,851,750
1908	1,773,326
1911	2,020,171
PARAGUAY.	
1899	2,283,000
1902	3,104,453
1908	5,500,000
1912	3,500,000
RUSSIA, EUROPEAN.	
1890	28,541,400
1900	34,483,900
1908	32,139,378
1910	34,615,715
1911	33,290,223
UNITED STATES.	
1890, June 1	51,363,572
1900, June 1	67,719,410
1910, April 15	61,803,866
1911	60,502,000
1912	57,959,000
1913	56,527,000
1914	57,592,000
URUGUAY.	
1900	6,827,428
1908	8,192,602
VENEZUELA.	
1909	6,000,000

The diminishing marketings of cattle since 1907, and especially since 1910, in Chicago, Kansas City, Omaha, St. Louis, Sioux City, St. Joseph, and St. Paul, tell the tale of a diminishing hide production in this country. As Table 11 shows, the number of cattle received at those markets in 1900 was 7,179,344, and the number steadily increased to 9,590,710 in 1907. There was a marked decline to 8,827,360 cattle in 1908, followed by a gain in the next two years, but since the marketing of 9,265,408 cattle in the cities named in 1910 the decline has been rapid to 7,904,552 cattle in 1913. During the first half of 1912 the receipts of cattle at these cities were 3,268,228; of 1913, 3,324,201; and of 1914, 2,994,501 cattle.

TABLE 11.—*Marketings of cattle and calves.*

[Combined receipts at Chicago, Kansas City, Omaha, St. Louis, Sioux City, St. Joseph, and St. Paul.]

Year.	Number.		Year.	Number.	
	Cattle.	Calves.[1]		Cattle.	Calves.[1]
1900	7,179,344	[2] 304,310	1910	9,265,408	981,309
1901	7,708,839	[2] 356,952	1911	8,768,456	975,176
1902	8,375,408	517,702	1912	8,159,888	909,526
1903	8,878,789	550,559	1913	7,904,552	740,662
1904	8,690,699	513,034			
			Jan. to June:		
1905	9,202,083	730,639	1912	3,268,228	477,465
1906	9,373,825	796,793	1913	3,324,201	371,662
1907	9,590,710	834,781	1914	2,994,501	345,783
1908	8,827,360	854,687			
1909	9,189,312	868,564			

[1] Receipts at Chicago, Kansas City, St. Joseph, St. Paul, and Sioux City. No returns for Omaha and St. Louis.
[2] No data for Sioux City.

The trend of the calf slaughter in this country, which has been regarded as excessive in recent years, is shown in Table 11 by the receipts of calves at the seven cities mentioned from 1900 to 1913 and during the first half of 1912, 1913, and 1914. From 1902, when 517,702 calves were received, the receipts increased to 981,309 in 1910, or nearly doubled in eight years. The decline during the three years since 1910 has been more marked than the increase during the three years preceding. During the first half of 1914 the receipts of calves at the seven cities were only about two-thirds of the number in the first half of 1912. While farmers may be raising more calves to maturity, it may be true on the other hand that fewer calves are born.

Apparently, the leather industries in this country may reckon on a diminishing supply of cattle hides from the United States for present purposes, and will need to depend on a redistribution of the world's supply in international trade, not only for any increase of imports but to prevent a great decrease.

The Fruit Commissioner's Branch of the Canadian Department of Agriculture, under date of July 13, 1914, reports that the 1914 Canadian apple crop, from current indications, will be above average, and one that, with proper attention given to distribution and marketing, will return to the growers satisfactory figures.

On April 1, 1914, there were in the United States postal service 43,068 rural free delivery routes with a total length of 1,045,903 miles, and 12,090 "star" routes having a total length of 154,427 miles; hence more than 1,000,000 miles of country roads are traversed regularly by United States mails.

TABLE 12.—*Corn and wheat: Condition, forecast, and price of corn, and price of all wheat, Aug. 1, 1914, with comparisons.*

State.	Corn.									All wheat.		
	Condition Aug. 1.		Forecast from condition.		Final estimates.		Price Aug. 1.			Price Aug. 1.		
	1914.	10-year average.	Aug. 1.	July 1.	1913.	5-year average, 1909–1913.	1914.	1913.	5-year average.	1914.	1913.	5-year average.
	P.c.	*P.c.*	*Bushels.*[1]	*Bushels.*[1]	*Bushels.*[1]	*Bushels.*[1]	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Maine	82	88	630	626	608	694	86	75	81	100	.....	117
New Hampshire	87	89	877	840	814	967	83	72	78	.....	.....	.....
Vermont	88	88	1,822	1,802	1,665	1,792	81	74	78	110	101	115
Massachusetts	90	89	2,160	1,963	1,944	2,041	91	80	83	.....	.....	.....
Rhode Island	93	93	430	416	402	430	108	100	98	.....	.....	.....
Connecticut	84	91	2,613	2,707	2,348	2,755	79	73	79	.....	.....	.....
New York	86	82	20,131	19,673	15,020	18,682	80	71	77	88	93	101
New Jersey	93	87	10,877	9,710	10,862	10,157	79	73	78	89	100	105
Pennsylvania	90	87	61,227	58,549	57,057	56,524	81	73	77	85	88	98
Delaware	87	88	6,341	5,886	6,206	6,089	80	75	76	84	85	93
Maryland	89	87	24,193	22,237	22,110	22,211	77	67	76	84	84	94
Virginia	82	87	46,469	44,644	51,480	46,959	92	82	87	90	92	100
West Virginia	76	89	19,471	19,863	22,692	20,137	90	77	86	90	98	106
North Carolina	83	87	51,767	49,881	55,282	47,884	100	93	97	94	101	109
South Carolina	76	85	33,022	35,629	38,512	31,564	99	96	100	110	116	123
Georgia	78	88	55,501	55,298	63,023	53,482	96	98	99	112	114	123
Florida	76	87	8,366	8,146	10,125	8,628	95	95	96	.....	.....	.....
Ohio	80	85	137,592	146,306	146,250	154,651	74	62	68	79	85	94
Indiana	67	85	149,212	189,448	176,400	186,900	72	61	65	78	82	91
Illinois	65	83	280,171	376,015	282,150	366,883	72	61	64	77	80	99
Michigan	86	80	60,387	63,822	56,112	54,829	71	63	69	81	85	94
Wisconsin	92	83	66,470	62,730	66,825	56,346	67	59	65	85	83	96
Minnesota	89	84	90,566	82,426	96,000	76,584	58	52	58	84	80	98
Iowa	91	84	396,341	404,796	338,300	352,236	64	54	59	73	78	88
Missouri	68	80	181,856	207,444	129,062	200,850	78	65	71	72	70	87
North Dakota	87	82	13,057	12,607	10,800	6,938	61	53	63	81	76	95
South Dakota	78	85	74,749	85,494	67,320	60,509	60	50	58	80	76	92
Nebraska	82	80	195,698	217,028	114,150	164,878	64	57	59	68	71	81
Kansas	74	72	133,478	138,800	23,424	129,700	77	66	66	68	75	84
Kentucky	62	85	76,942	96,086	74,825	92,543	91	76	80	78	85	94
Tennessee	70	86	69,178	77,720	68,675	80,767	93	76	83	80	90	99
Alabama	69	86	44,593	48,372	55,360	49,107	100	89	94	118	108	113
Mississippi	69	83	50,408	53,333	63,000	51,108	92	86	90	78	100	108
Louisiana	72	83	36,252	42,798	41,800	35,131	90	84	83	100	.....	.....
Texas	64	75	115,154	138,611	163,200	120,286	88	69	79	76	83	96
Oklahoma	42	70	50,274	73,744	52,250	75,412	75	63	69	68	70	84
Arkansas	58	82	36,236	40,817	47,025	48,439	89	78	84	71	82	95
Montana	91	87	1,081	1,004	882	533	.....	77	111	70	70	92
Wyoming	83	85	480	527	493	268	100	40	75	101	82	108
Colorado	97	84	10,979	10,644	6,300	6,409	71	54	72	76	72	94
New Mexico	99	84	2,643	2,478	1,572	1,838	79	71	99	94	76	107
Arizona	95	87	607	592	476	457	125	118	108	95	106	104
Utah	97	92	366	359	340	254	75	67	85	72	74	87
Nevada	97	95	34	34	34	20	.....	115	109	86	90	109
Idaho	89	92	605	585	448	362	82	77	85	71	73	81
Washington	89	90	993	972	952	800	70	76	85	70	73	81
Oregon	89	91	627	634	598	542	67	82	100	77	75	87
California	93	88	2,288	2,386	1,815	1,745	82	81	87	90	91	100
United States	74.8	81.9	2,634,214	2,916,572	2,446,988	2,708,334	76.8	65.4	70.6	76.5	77.1	91.1

[1] Thousands (000) omitted.

TABLE 13.—*Winter and spring wheat: Preliminary estimate of production of winter wheat; condition and forecast, Aug. 1, 1914, of spring wheat, with comparisons.*

State.	Winter wheat.						Spring wheat.					
	Yield per acre.		Production, 1914.	Forecast July 1, from condition.	Final estimates.		Condition, Aug. 1.		Forecast from condition.		Final estimates.	
	1914.	10-year average.			1913.	5-year average, 1909–1913.	1914.	10-year average.	Aug. 1.	July 1.	1913.	5-year average, 1909–1913.
	Bu.	Bu.	Bu.[1]	Bu.[1]	Bu.[1]	Bu.[1]	P.c.	P.c.	Bu.[1]	Bu.[1]	Bu.[1]	Bu.[1]
Maine	...	...	...	...	...	...	95	95	77	76	76	77
Vermont	...	...	...	...	...	...	95	90	27	24	24	24
New York	22.5	18.7	8,100	7,614	6,800	6,793	...	...	...	...	...	...
New Jersey	18.0	17.4	1,422	1,232	1,408	1,475	...	...	...	...	...	...
Pennsylvania	18.2	16.9	23,878	21,915	21,862	21,290	...	...	...	...	...	...
Delaware	20.5	16.0	2,337	1,971	1,638	1,817	...	...	...	...	...	...
Maryland	21.5	15.7	13,158	10,355	8,113	9,290	...	...	...	...	...	...
Virginia	14.0	11.9	10,906	9,815	10,608	9,171	...	...	...	...	...	...
West Virginia	15.0	12.5	3,540	3,170	3,055	2,952	...	...	...	...	...	...
North Carolina	11.5	9.6	7,026	6,592	7,078	5,936	...	...	...	...	...	...
South Carolina	11.5	9.5	920	863	972	761	...	...	...	...	...	...
Georgia	12.0	9.8	1,680	1,638	1,708	1,382	...	...	...	...	...	...
Ohio	18.5	15.5	38,665	38,456	35,100	29,238	...	...	...	...	...	...
Indiana	17.4	15.1	43,239	42,966	39,775	30,668	...	...	...	...	...	...
Illinois	18.8	15.6	48,429	44,374	41,888	33,640	...	...	...	...	...	...
Michigan	20.0	15.4	17,580	16,104	12,776	14,220	...	...	...	...	...	...
Wisconsin	21.5	18.8	1,828	1,778	1,749	1,591	87	86	1,783	1,869	1,916	1,719
Minnesota	19.5	...	800	...	810	[2] 810	63	83	45,148	62,000	67,230	59,859
Iowa	21.6	20.6	10,346	10,897	10,530	6,272	80	86	4,978	5,602	5,865	5,548
Missouri	17.0	13.6	43,333	40,835	39,586	31,048	...	...	...	...	...	...
North Dakota	...	...	...	...	...	...	81	76	88,513	95,871	78,855	90,231
South Dakota	14.0	...	966	...	900	[2] 900	69	78	36,613	48,176	33,075	38,768
Nebraska	19.3	18.1	60,274	68,238	58,125	45,392	70	78	4,130	5,423	4,200	3,687
Kansas	20.5	13.4	162,975	151,050	86,515	73,676	79	63	822	857	468	618
Kentucky	16.5	12.1	12,292	10,986	9,860	9,037	...	...	...	...	...	...
Tennessee	15.0	10.7	10,635	9,166	8,400	7,718	...	...	...	...	...	...
Alabama	13.0	10.9	403	380	374	297	...	...	...	...	...	...
Mississippi	13.0	11.8	13	13	14	59	...	...	...	...	...	...
Texas	13.0	11.6	14,066	14,282	13,650	8,863	...	...	...	...	...	...
Oklahoma	19.0	11.5	46,835	43,138	17,500	17,224	...	...	...	...	...	...
Arkansas	13.5	10.7	1,418	1,289	1,313	999	...	...	...	...	...	...
Montana	23.0	27.3	11,063	13,276	12,288	7,636	85	87	10,210	10,800	8,385	5,618
Wyoming	24.0	26.9	984	1,194	1,000	654	80	89	1,320	1,476	1,250	1,019
Colorado	25.0	23.3	4,850	5,457	4,220	3,762	94	85	7,442	7,391	5,460	5,266
New Mexico	25.0	20.9	1,050	1,041	651	530	98	86	760	760	570	477
Arizona	28.0	28.8	868	903	928	642	85	90	...	...	...	48
Utah	25.0	22.4	5,575	5,914	4,600	3,311	97	95	1,979	1,979	1,820	1,853
Nevada	29.0	24.3	522	445	368	317	98	97	820	812	713	568
Idaho	27.5	27.6	9,322	9,823	8,494	8,600	92	90	5,603	5,686	5,600	4,483
Washington	27.2	26.3	32,667	32,632	32,400	24,609	89	82	22,546	21,819	20,900	22,227
Oregon	22.0	22.9	13,684	15,227	12,305	12,955	86	83	3,349	3,382	3,412	3,399
California	18.3	14.8	7,466	7,946	4,200	7,047	...	...	...	...	...	...
United States	19.1	15.0	675,115	652,975	523,561	441,212	75.5	80.1	236,120	274,003	239,819	245,479

[1] Thousands (000) omitted. [2] 1913 only.

TABLE 14.—*Oats and barley: Condition, forecast, and price, Aug. 1, 1914, with comparisons.*

State.	Oats.							Barley.						
	Condition, Aug. 1.		Forecast from condition.		5-year average, 1909-1913; final estimates.	Price, Aug. 1.		Condition, Aug. 1.		Forecast from condition.		5-year average, 1909-1913; final estimates.	Price, Aug. 1.	
	1914.	10-year average.	Aug. 1.	July 1.		1914.	5-year average.	1914.	10-year average.	Aug. 1.	July 1.		1914.	5-year average.
	P.c.	*P.c.*	*Bush.*[1]	*Bush.*[1]	*Bush.*[1]	*Cts.*	*Cts.*	*P.c.*	*P.c.*	*Bush.*[1]	*Bush.*[1]	*Bush.*[1]	*Cts.*	*Cts.*
Maine	98	95	5,596	5,539	5,029	60	60	95	92	147	140	118	95	89
New Hampshire	95	92	445	425	430	65	60	89	91	26	26	25	90	92
Vermont	96	92	3,147	2,969	2,869	56	59	90	92	367	362	372	85	89
Massachusetts	94	91	321	297	284	56	60	....	....	....	....	....	....	....
Rhode Island	83	89	56	56	57	51	62	....	....	....	....	....	90	....
Connecticut	92	89	374	345	342	50	58	....	....	....	....	....	....	....
New York	89	88	39,450	38,384	39,681	49	54	90	89	2,025	1,947	2,081	66	80
New Jersey	91	86	2,195	1,965	1,990	47	53	....	....	....	....	....	....	....
Pennsylvania	83	88	32,061	30,474	34,464	48	53	86	89	175	166	179	65	71
Delaware	63	86	89	89	119	45	51	....	....	....	....	....	....	....
Maryland	70	87	1,008	993	1,285	51	51	85	90	139	144	121	70	62
Virginia	56	83	2,621	2,714	3,839	56	56	85	91	280	274	263	75	71
West Virginia	52	87	1,602	1,724	2,558	52	58	....	....	....	....	....	....	....
North Carolina	72	83	3,594	3,445	3,740	57	63	....	....	....	....	....	....	....
South Carolina	77	83	7,291	7,168	7,053	65	67	....	....	....	....	....	....	....
Georgia	78	86	7,912	7,912	7,810	62	69	....	....	....	....	....	100	....
Florida	72	81	648	648	701	67	73	....	....	....	....	....	....	....
Ohio	74	84	51,335	50,642	65,129	36	43	79	85	1,002	982	664	52	63
Indiana	64	80	40,212	40,841	54,666	35	37	80	85	200	211	242	44	65
Illinois	70	77	125,815	120,748	144,625	35	37	85	89	1,520	1,566	1,603	54	63
Michigan	91	83	52,389	51,571	47,021	38	46	90	86	2,309	2,346	2,216	63	68
Wisconsin	83	85	77,987	84,854	74,644	37	45	86	86	19,752	20,066	21,351	52	69
Minnesota	75	83	92,340	110,656	96,426	31	39	80	82	33,623	35,366	34,044	40	57
Iowa	84	84	159,403	172,318	166,676	31	36	87	87	10,356	10,714	12,395	48	58
Missouri	58	73	24,868	24,990	29,307	38	40	65	83	92	105	140	....	67
North Dakota	84	77	71,070	74,083	57,063	32	43	80	78	29,172	30,830	22,700	37	53
South Dakota	74	80	41,595	49,866	37,027	31	40	77	79	19,426	22,138	17,368	41	57
Nebraska	86	75	67,063	67,341	54,828	31	37	85	77	2,689	2,837	1,981	39	47
Kansas	87	66	56,532	54,801	39,612	32	41	82	62	5,314	5,304	2,921	45	50
Kentucky	65	77	2,903	2,846	3,422	50	52	88	87	78	79	76	65	....
Tennessee	73	83	5,580	5,516	6,126	49	51	90	86	52	52	62	82	74
Alabama	85	84	6,862	6,792	5,157	62	67	....	....	....	....	....	....	....
Mississippi	82	82	2,852	2,927	2,146	61	65	....	....	....	....	....	....	....
Louisiana	84	81	1,070	1,066	746	60	60	....	....	....	....	....	....	....
Texas	62	73	25,215	28,616	22,651	41	44	85	76	224	218	127	45	80
Oklahoma	80	67	31,406	32,467	18,467	35	40	88	70	197	187	156	45	50
Arkansas	78	77	5,568	5,518	4,569	51	54	....	....	....	....	....	....	....
Montana	88	88	23,320	25,191	18,878	35	50	85	90	2,076	2,313	1,189	56	76
Wyoming	86	91	8,533	8,906	6,399	58	62	90	91	441	464	327	99	79
Colorado	97	87	13,402	10,397	10,397	42	56	96	89	3,955	3,987	2,530	57	70
New Mexico	98	84	1,999	1,880	1,415	55	62	98	85	141	137	65	75	71
Arizona	93	94	335	338	242	55	63	90	92	1,365	1,380	1,294	55	70
Utah	100	96	4,464	4,419	3,825	41	57	99	95	1,362	1,376	1,006	47	61
Nevada	94	95	508	518	376	57	65	96	97	512	522	467	64	87
Idaho	94	93	14,824	15,136	14,061	33	48	96	93	7,779	7,887	5,905	56	58
Washington	91	90	14,324	14,517	13,493	37	51	93	89	7,194	7,237	6,522	45	59
Oregon	87	89	12,667	13,628	12,906	36	50	93	90	4,255	4,153	3,673	56	67
California	93	85	8,389	8,569	6,624	48	55	96	83	44,415	45,803	37,690	43	65
United States	79.4	80.9	1,153,240	1,197,105	1,131,175	36.7	42.8	85.3	82.1	202,660	211,319	181,873	45.1	60.6

[1] Thousands (000) om tted.

TABLE 15.—*Rye and buckwheat: Acreage, production, quality, and price of rye; acreage, condition, forecast, and price of buckwheat, with comparisons.*

State.	Rye.								Buckwheat.							
	Preliminary estimates.			5-year average, 1909-1913; final estimates.	Quality.		Price, Aug. 1.		Acreage.		Condition, Aug. 1.		Forecast from condition.	5-year average, 1909-1913; final estimates.	Price, Aug. 1.	
	Acreage.	Yield per acre.	Production.		1914.	10-year average.	1914.	5-year average.	Per cent of 1913.	Total.	1914.	10-year average.			1914.	5-year average.
	Acres[1]	*Bu.*	*Bu.*[1]	*Bu.*[1]	*P.c.*	*P.c.*	*Cts.*	*Cts.*	*P.c.*	*Acres*[1]	*P.c.*	*P.c.*	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*
Maine	...	...	...	...	...	...	...	...	95	12	95	93	382	423	70	79
New Hampshire	...	...	...	...	...	...	85	...	102	1	95	93	29	29	...	78
Vermont	1	20.0	20	19	98	94	76	...	95	8	92	90	199	200	85	87
Massachusetts	3	19.0	57	54	96	94	92	98	102	2	96	91	44	39	...	93
Rhode Island	...	...	...	...	...	...	105	...	...	...	...	...	...	...	...	...
Connecticut	7	19.0	133	141	97	97	96	95	95	3	94	92	59	56	110	97
New York	129	17.7	2,283	2,245	94	94	71	82	98	274	91	88	6,358	5,766	85	81
New Jersey	70	18.0	1,260	1,197	95	94	70	82	100	10	94	86	244	247	105	96
Pennsylvania	280	17.5	4,900	4,506	95	94	72	79	100	280	90	90	5,922	5,894	78	74
Delaware	1	17.5	18	14	93	93	80	77	90	3	81	90	52	65	...	...
Maryland	23	17.0	391	408	95	92	70	73	99	11	90	91	208	198	76	80
Virginia	58	13.0	754	596	94	91	83	83	102	23	76	92	375	443	90	81
West Virginia	17	14.5	246	201	95	92	79	86	96	36	87	94	783	792	80	78
North Carolina	46	10.0	460	427	94	91	94	99	100	9	80	89	155	178	82	83
South Carolina	3	11.5	34	28	90	90	179	147	...	...	...	...	...	...	...	...
Georgia	13	9.2	120	105	93	91	100	143	...	...	...	...	...	...	...	...
Florida	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ohio	94	16.5	1,551	1,082	94	93	64	75	110	20	85	89	374	406	72	76
Indiana	99	16.3	1,614	1,176	95	92	57	70	100	5	65	88	66	94	95	74
Illinois	49	16.2	794	849	94	92	59	73	95	4	85	84	75	79	100	96
Michigan	379	16.0	6,064	5,666	96	93	57	70	99	59	88	85	986	1,051	79	72
Wisconsin	412	17.0	7,004	5,990	95	92	56	70	95	17	92	86	289	297	71	75
Minnesota	279	18.8	5,245	4,998	91	91	50	64	100	6	90	88	108	125	58	72
Iowa	59	19.0	1,121	703	90	93	63	67	95	6	87	86	99	116	96	98
Missouri	17	15.0	255	233	93	91	66	79	99	2	60	84	216	25	...	111
North Dakota	131	17.1	2,240	841	92	90	45	62	...	...	...	...	...	...	...	...
South Dakota	50	17.0	850	304	90	90	...	62	...	...	...	...	...	...	...	...
Nebraska	122	16.0	1,952	980	91	91	47	61	100	1	85	86	19	17	...	105
Kansas	50	19.8	990	349	94	88	64	72	125	1	70	85	12	12	...	...
Kentucky	22	13.7	301	278	93	89	74	85	...	...	...	...	...	...	80	...
Tennessee	21	13.0	273	202	96	90	89	90	98	3	75	91	42	45	...	82
Alabama	1	13.0	13	10	91	89	90	133	...	...	...	...	...	...	...	...
Mississippi	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Louisiana	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Texas	2	14.8	30	20	86	85	95	100	...	...	...	...	...	...	...	...
Oklahoma	6	16.0	96	45	93	87	73	84	...	...	...	...	...	...	...	...
Arkansas	1	11.0	11	10	91	87	92	99	...	...	...	...	...	...	...	...
Montana	10	21.0	210	172	97	95	69	78	...	...	...	...	...	...	...	...
Wyoming	4	16.0	64	42	92	97	85	84	...	...	...	...	...	...	...	...
Colorado	21	17.5	368	312	98	92	64	73	...	...	...	...	...	...	...	...
New Mexico	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Arizona	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Utah	13	17.5	228	106	99	97	...	72	...	...	...	...	...	...	...	...
Nevada	...	...	...	...	...	...	55	...	...	...	...	...	...	...	...	...
Idaho	3	20.0	60	60	97	97	65	73	...	...	...	...	...	...	...	...
Washington	8	19.7	158	140	96	94	65	84	...	...	...	...	...	...	...	...
Oregon	21	16.0	336	285	94	95	100	93	...	...	...	...	...	...	...	...
California	8	20.0	160	117	98	93	94	88	...	...	...	...	...	...	...	...
United States	2,533	16.8	42,664	34,911	94.0	92.8	61.0	73.4	98.9	796	88.8	89.1	17,091	16,597	81.2	77.9

[1] Thousands (000) omitted.

TABLE 16.—*Potatoes: Condition, forecast, and price, Aug. 1, 1914, with comparisons.*

State.	Potatoes.									Sweet potatoes.						
	Conditions Aug. 1.		Forecast from condition.		Final estimates.		Price, Aug. 1.			Condition, Aug. 1.		Forecast, 1914, from condition.	Final estimates.		Price, July 15.	
	1914.	10-year average.	Aug. 1.	July 1.	1913.	5-year average, 1909-1913.	1914.	1913.	5-year average.	1914.	10-year average.		1913.	5-year average, 1909-1913.	1914.	5-year average.
	P.c.	*P.c.*	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*	*Cts.*	*P.c.*	*P.c.*	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*
Maine	97	91	29,178	27,085	28,160	26,077	87	45	77	....	....	....	....	....	....	....
New Hampshire	97	89	2,474	2,142	2,074	2,298	114	75	91	....	....	....	....	....	....	....
Vermont	97	88	3,638	3,150	3,175	3,414	73	75	83	....	....	....	....	....	....	....
Massachusetts	94	86	3,563	3,256	2,835	2,922	120	99	109	....	....	....	....	....	....	....
Rhode Island	96	85	744	658	650	600	103	75	98	....	....	....	....	....	....	....
Connecticut	97	85	3,026	2,621	2,208	2,437	102	101	110	....	....	....	....	....	....	....
New York	91	85	40,076	36,737	26,640	36,288	95	74	86	....	....	....	....	....	....	....
New Jersey	81	79	9,539	8,346	8,930	8,438	71	70	81	84	87	2,846	3,174	3,066	....	....
Pennsylvania	82	83	23,295	22,383	23,320	22,653	97	85	91	91	87	120	110	117	....	....
Delaware	70	81	909	847	957	946	87	55	77	84	86	601	675	657	62	134
Maryland	69	81	3,264	3,225	3,741	3,383	84	56	82	85	85	966	1,128	999	....	....
Virginia	63	86	7,079	6,148	9,870	8,137	87	71	80	80	87	2,902	3,564	3,771	115	82
West Virginia	50	85	2,640	3,006	3,984	3,889	117	82	88	76	87	192	182	210	135	115
North Carolina	57	84	1,624	1,693	2,400	2,349	102	73	84	80	88	6,810	8,000	7,737	75	75
South Carolina	65	81	670	656	800	816	137	139	117	76	87	4,049	4,600	4,508	93	83
Georgia	70	86	781	764	972	928	115	104	114	80	88	6,383	7,221	7,111	90	96
Florida	85	84	1,216	1,149	912	918	130	114	125	85	90	1,986	2,310	2,278	100	87
Ohio	70	80	11,945	11,888	10,240	16,193	114	81	96	75	85	94	90	110	135	121
Indiana	51	77	4,380	5,145	3,975	7,222	116	82	93	72	84	91	78	118	150	110
Illinois	50	75	6,634	7,738	5,750	9,921	126	90	97	54	82	531	560	841	....	....
Michigan	86	82	38,191	37,099	33,600	35,273	87	72	85	....	....	....	....	....	....	....
Wisconsin	90	83	35,568	33,197	32,155	31,625	69	38	76	....	....	....	....	....	....	....
Minnesota	86	84	30,841	28,612	30,250	25,885	62	51	74	....	....	....	....	....	....	....
Iowa	76	80	13,406	13,377	7,200	13,227	97	86	103	79	85	190	160	196	....	....
Missouri	45	76	3,915	4,402	3,230	6,034	121	88	96	63	82	435	336	639	120	106
North Dakota	86	84	6,190	6,454	5,100	4,797	88	42	88	....	....	....	....	....	....	....
South Dakota	80	84	4,960	5,362	4,680	4,217	96	70	113	....	....	....	....	....	....	....
Nebraska	74	77	8,658	9,582	5,664	7,231	102	87	113	....	....	....	....	....	....	....
Kansas	64	71	4,193	4,774	2,920	4,148	101	90	109	82	80	472	250	437	135	168
Kentucky	33	84	1,649	2,422	2,450	4,000	115	86	93	71	86	665	675	941	100	92
Tennessee	44	84	1,506	1,839	2,432	2,691	123	77	83	70	87	1,343	1,600	1,997	105	102
Alabama	65	84	1,123	1,184	1,512	1,245	123	103	103	71	89	4,876	6,650	6,014	85	95
Mississippi	66	84	832	864	960	801	108	88	101	68	87	3,632	5,390	4,979	80	82
Louisiana	76	81	1,587	1,673	1,750	1,457	87	75	79	77	89	4,433	5,100	5,007	88	103
Texas	75	74	2,739	2,605	2,340	2,691	104	81	106	70	77	3,567	4,000	2,924	125	122
Oklahoma	75	73	2,112	2,227	1,920	1,604	87	71	105	65	80	429	384	352	130	124
Arkansas	61	81	1,391	1,404	1,800	1,919	113	78	96	65	85	1,287	1,800	1,813	115	96
Montana	87	90	5,472	5,565	5,040	4,215	76	65	104	....	....	....	....	....	....	....
Wyoming	86	89	1,733	1,755	1,680	1,094	110	87	133	....	....	....	....	....	....	....
Colorado	89	86	9,372	9,532	9,200	8,161	83	60	105	....	....	....	....	....	....	....
New Mexico	98	79	1,132	993	612	644	128	109	122	....	....	....	....	....	....	....
Arizona	92	81	106	99	75	97	175	120	132	....	....	....	....	....	....	....
Utah	87	92	3,471	3,574	3,600	2,722	75	75	86	....	....	....	....	....	....	....
Nevada	93	96	1,920	1,940	1,760	1,369	70	85	126	....	....	....	....	....	....	....
Idaho	85	92	5,491	5,409	5,780	5,232	79	49	84	....	....	....	....	....	....	....
Washington	88	90	8,826	9,248	7,380	8,636	70	68	84	....	....	....	....	....	....	....
Oregon	90	92	6,394	6,311	6,750	6,408	69	60	86	....	....	....	....	....	....	....
California	92	89	10,212	10,474	8,092	9,375	60	60	85	95	90	986	1,020	806	175	....
United States	79.0	83.1	369,634	360,614	331,525	356,627	87.1	69.2	88.3	75.5	86.5	49,886	59,057	57,628	94.5	95.0

[1] Thousands (000) omitted.

TABLE 17.—*Flax, rice, and tobacco: Condition, forecast, and price, Aug. 1, 1914, with comparisons.*

State.	Flaxseed.						Rice.				Tobacco.				
	Condition, Aug. 1.		Forecast, 1914, from condition.	Final estimate, 1913.	Price, Aug. 1.		Condition, Aug. 1.		Forecast, 1914, from condition.	Final estimate, 1913.	Condition, Aug. 1.		Forecast, 1914, from condition.	Final estimates.	
	1914.	10-year average.			1914.	5-year average.	1914.	10-year average.			1914.	10-year average.		1913.	5-year average, 1909-1913.
	P.c.	P.c.	Bu.[1]	Bu.[1]	Cts.	Cts.	P.c.	P.c.	Bu.[1]	Bu.[1]	P.c.	P.c.	Lbs.[1]	Lbs.[1]	Lbs.[1]
Maine															
New Hampshire											92	91	175	165	163
Vermont											92	90	175	155	164
Massachusetts											93	88	11,662	9,455	9,524
Rhode Island															
Connecticut											96	91	36,457	28,520	28,337
New York											93	88	6,203	4,386	4,997
New Jersey															
Pennsylvania											86	88	45,830	46,680	57,351
Delaware															
Maryland											70	82	12,320	18,500	18,663
Virginia											65	82	93,600	154,000	135,388
West Virginia											53	84	5,152	10,200	12,763
North Carolina							85	85	5	7	70	81	126,000	167,500	127,339
South Carolina							86	86	169	147	74	83	30,976	33,288	22,027
Georgia							90	86	38	16	80	88	1,368	1,800	1,323
Florida							86	84	10	10	84	90	3,359	4,000	2,987
Ohio											68	83	60,795	61,425	79,966
Indiana											65	80	9,477	11,925	18,939
Illinois											75	82	428	560	842
Michigan															
Wisconsin	91	88	111	126		175					91	83	60,999	50,740	47,807
Minnesota	82	86	2,893	3,150	155	166									
Iowa	88	88	275	263	138	156									
Missouri	80	78	56	50		141					60	80	2,829	3,315	5,578
North Dakota	83	80	7,408	7,200	152	171									
South Dakota	75	85	2,550	3,060	148	163									
Nebraska	71	87	49	54	125	156									
Kansas	82	76	328	300	130	146									
Kentucky											60	79	244,755	281,200	350,502
Tennessee											52	80	37,833	64,800	70,426
Alabama							85	86	6	4	75	87	105	210	153
Mississippi							80	86	40	42	71	83			
Louisiana							88	89	11,224	11,760	93	83	384	270	218
Texas							88	89	8,320	9,696	65	81	105	120	159
Oklahoma															
Arkansas							85	88	3,366	3,769	70	83	392	520	471
Montana	87	92	3,090	3,600	150	178									
Wyoming															
Colorado	88		60	50											
New Mexico															
Arizona															
Utah															
Nevada															
Idaho															
Washington															
Oregon															
California							91		747	293					
United States	82.1	82.6	16,820	17,853	150.7	167.9	87.6	88.4	23,925	25,744	66.5	81.5	791,379	953,734	996,087

[1] Thousands (000) omitted.

Table 18.—*Hay and clover: Acreage, condition, forecast, and price of hay; production and quality of clover, Aug. 1, 1914, with comparisons.*

State.	Hay.										Clover.					
	Acreage (tame).		Condition, Aug. 1.		Forecast, Aug. 1.	Final estimates.		Price, Aug. 1.			Yield per acre.		Production: per cent of full crop.		Quality.	
	Per cent of 1913.	Acres.	1914.	6-yr. average.		1913.	5-yr. aver., 1909-1913.	1914.	1913.	5-yr. average.	1914.	1913.	1914.	1913.	1914.	1913.
	P.c.	Acres[1]	P.c.	P.c.	Tons.[1]	Tons.[1]	Tons[1]	Dols.	Dols.	Dols.	Ts.	Ts.	P.c.	P.c.	P.c.	P.c.
Maine	103	1,230	97	87	1,492	1,194	1,299	13.60	13.70	13.80	1.50	1.40	96	72	98	95
New Hampshire	105	520	98	85	642	495	538	18.40	16.50	16.56	1.53	1.45	93	79	99	94
Vermont	99	990	85	90	1,237	1,280	1,310	14.70	13.60	12.94	1.60	1.50	77	77	93	94
Massachusetts	101	480	91	87	612	575	582	19.50	20.10	20.28	1.60	1.60	90	83	95	94
Rhode Island	100	58	75	90	56	68	67	23.30	22.00	22.44	1.50	1.40	80	94	80	97
Connecticut	99	375	88	86	445	432	441	19.80	20.00	21.94	1.50	1.57	84	90	80	98
New York	99	4,653	83	82	5,600	5,358	5,498	14.50	14.00	14.54	1.21	1.25	75	77	89	94
New Jersey	100	361	80	84	462	469	472	18.40	17.70	18.38	1.37	1.30	76	75	85	92
Pennsylvania	100	3,141	89	84	4,333	4,146	3,840	13.50	13.80	15.32	1.40	1.20	81	78	92	90
Delaware	100	72	78	83	87	94	88	16.00	14.00	15.40	1.10	1.27	78	85	88	93
Maryland	100	390	78	78	487	491	453	14.20	11.50	15.68	1.13	1.10	74	65	89	81
Virginia	85	638	60	81	555	952	793	17.30	13.00	15.66	.80	1.35	60	86	82	91
West Virginia	94	696	61	81	637	925	770	16.70	13.70	15.28	.92	1.50	59	86	86	89
North Carolina	96	307	79	86	376	419	375	18.20	15.00	15.88	1.20	1.45	75	91	90	96
South Carolina	100	210	75	86	220	244	219	18.10	18.10	18.46	1.50	1.70	70	88	85	97
Georgia	98	245	80	90	304	350	293	17.60	18.40	18.28	1.45	1.30	83	87	89	93
Florida	95	45	91	90	62	63	52	19.00	18.00	17.60	....	....	....	....	....	....
Ohio	95	2,812	80	85	3,554	3,848	3,838	12.60	10.00	12.54	1.14	1.42	74	88	94	93
Indiana	98	1,764	77	82	2,105	1,800	2,194	13.60	11.40	11.94	.95	1.10	65	71	90	85
Illinois	85	2,125	67	82	2,136	2,450	3,168	14.50	11.80	12.48	.95	1.25	60	85	90	92
Michigan	98	2,352	90	85	3,175	2,520	3,004	12.10	12.00	12.70	1.29	1.08	84	72	94	92
Wisconsin	105	2,494	100	87	4,190	3,848	3,301	9.60	9.50	12.56	1.89	1.80	1.01	95	94	92
Minnesota	105	1,743	98	81	3,074	2,490	2,265	6.50	6.20	8.28	1.95	1.70	1.04	79	96	90
Iowa	97	2,910	90	86	4 059	4,440	4,511	9.40	7.90	9.20	1.45	1.58	87	94	96	99
Missouri	88	2,640	60	79	2,218	1,800	3,115	14.90	11.30	10.60	.77	1.00	57	70	80	90
North Dakota	107	364	98	78	535	388	403	5.10	5.20	6.10	1.50	1.05	95	70	97	93
South Dakota	105	483	94	76	727	552	514	5.90	5.30	7.08	1.75	1.35	98	90	98	93
Nebraska	101	1,262	89	78	1,853	1,675	1,591	7.20	7.70	8.38	1.50	1.37	90	86	94	96
Kansas	110	1,650	83	78	2,191	1,350	1,988	7.90	8.90	8.32	1.20	1.05	80	77	91	96
Kentucky	95	736	65	80	718	674	919	17.30	14.40	14.62	.90	1.02	56	72	84	87
Tennessee	84	756	62	84	750	1,089	1,117	18.40	14.40	14.38	1.00	1.30	62	81	86	95
Alabama	95	200	78	89	250	286	268	15.00	15.00	13.82	1.55	1.60	87	90	92	95
Mississippi	88	194	72	90	230	293	275	13.20	12.00	12.26	1.70	1.85	83	93	91	94
Louisiana	101	162	82	90	233	240	235	12.40	11.60	11.60	1.70	1.75	90	94	94	92
Texas	105	420	92	79	580	464	444	9.50	10.00	10.56	2.00	....	102	80	90	....
Oklahoma	97	436	73	75	430	382	388	8.50	7.30	7.70	1.10	1.60	92	80	90	87
Arkansas	95	304	73	84	333	384	363	12.20	11.90	10.88	1.15	1.20	78	79	88	90
Montana	104	686	92	91	1,231	1,188	1,109	7.60	8.50	10.14	2.00	2.10	103	92	96	97
Wyoming	100	480	95	91	1,094	912	819	7.80	7.50	9.40	2.08	1.90	102	99	98	98
Colorado	109	970	100	87	2,425	1,824	1,707	8.00	8.50	10.02	2.00	2.25	107	90	98	94
New Mexico	106	204	98	91	519	399	387	11.00	9.50	10.74	1.40	1.50	110	95	93	99
Arizona	105	142	95	94	472	540	350	10.00	10.10	10.58	....	....	....	....	....	....
Utah	104	406	97	92	1,162	909	943	8.60	8.30	7.88	2.20	3.00	102	97	100	97
Nevada	105	247	100	95	766	646	587	8.00	9.20	10.32	2.60	2.35	103	100	100	....
Idaho	100	705	93	93	2,033	2,044	1,879	6.70	7.00	7.58	2.50	2.40	101	97	97	91
Washington	102	796	93	94	1,776	1,794	1,620	9.80	10.50	12.20	2.27	2.30	95	101	98	93
Oregon	104	858	99	92	1,953	1,732	1,578	7.20	8.50	9.40	2.10	2.25	105	101	98	92
California	112	2,688	97	86	5,085	3,600	4,017	8.10	14.50	11.26	2.00	2.10	98	94	93	94
United States	98.9	48,400	86.7	83.9	69,464	64,116	65,987	11.52	11.16	11.97	1.19	1.30	73.5	81.0	91.2	91.9

[1] Thousands (000) omitted.

TABLE 19.—*Hay and grasses; condition, Aug. 1, 1914, with comparisons.*

State.	Timothy.		Alfalfa.		Millet.		Kafir corn.		Field peas.		Cowpeas.		Blue grass (for seed).		Pasture.	
	Condition, Aug. 1.															
	1914.	10-year average.	1914.	8-year average.	1914.	8-year average.	1914.	8-year average.	1914.	8-year average.	1914.	8-year average.	1914.	8-year average.	1914.	10-year average.
	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.
Maine	97	91	.....	.....	90	88	.....	.....	.....	90	.....	.....	.....	.....	95	90
New Hampshire	97	90	.....	.....	92	86	.....	.....	.....	.....	100	.....	.....	.....	96	84
Vermont	86	94	.....	.....	93	85	.....	.....	95	89	100	.....	.....	.....	89	90
Massachusetts	90	90	.....	.....	93	87	.....	.....	94	.....	82	.....	.....	.....	92	83
Rhode Island	80	91	.....	.....	85	.....	.....	.....	90	.....	100	.....	.....	.....	85	82
Connecticut	88	90	.....	.....	90	83	.....	.....	90	.....	95	.....	.....	.....	92	82
New York	84	84	92	90	86	82	.....	.....	90	86	87	84	.....	.....	85	82
New Jersey	81	84	91	91	89	86	.....	.....	93	.....	89	88	.....	.....	85	78
Pennsylvania	89	85	90	90	88	86	.....	.....	91	.....	89	85	.....	.....	86	83
Delaware	72	84	84	90	70	.....	.....	.....	80	79	83	87	.....	.....	66	89
Maryland	75	81	87	85	78	80	.....	.....	92	77	86	84	.....	.....	69	79
Virginia	55	82	75	85	71	84	.....	.....	71	.....	81	83	.....	.....	69	86
West Virginia	59	84	81	87	81	85	.....	.....	75	86	79	88	64	86	61	91
North Carolina	71	87	80	86	76	87	.....	.....	75	83	80	85	.....	.....	73	90
South Carolina	80	88	76	86	78	84	.....	.....	84	83	76	84	.....	.....	71	88
Georgia	74	88	75	88	77	88	.....	.....	77	.....	82	88	.....	.....	75	91
Florida	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	87	87	.....	.....	86	93
Ohio	76	84	89	88	73	87	.....	.....	83	86	74	89	85	85	67	88
Indiana	67	81	82	87	67	82	.....	.....	50	83	67	85	60	84	51	83
Illinois	60	82	87	86	57	82	45	80	80	84	50	84	62	83	40	79
Michigan	88	84	90	82	86	83	.....	.....	91	83	85	84	100	77	85	78
Wisconsin	99	89	97	87	93	85	92	83	90	84	97	86	96	81	94	83
Minnesota	97	83	96	86	92	84	.....	.....	95	88	94	86	98	85	94	86
Iowa	85	84	93	91	89	85	.....	.....	93	87	85	80	81	80	77	82
Missouri	50	76	78	86	64	78	77	81	55	80	66	85	72	80	45	81
North Dakota	96	82	96	83	87	80	.....	.....	95	.....	87	78	.....	.....	91	85
South Dakota	92	82	86	85	80	82	.....	.....	77	.....	.....	90	.....	.....	85	86
Nebraska	91	82	86	82	85	77	87	79	90	.....	85	81	.....	.....	78	80
Kansas	75	78	88	80	88	81	85	78	90	.....	87	83	86	77	75	80
Kentucky	63	81	71	85	60	82	.....	.....	65	82	65	85	85	76	48	87
Tennessee	61	84	77	87	67	83	.....	.....	76	.....	68	88	85	.....	55	90
Alabama	78	89	77	88	68	86	.....	.....	73	.....	75	88	.....	.....	69	93
Mississippi	85	88	70	86	84	83	.....	.....	70	.....	73	86	.....	.....	68	94
Louisiana	96	90	80	87	90	86	.....	.....	73	.....	73	86	.....	.....	82	94
Texas	80	76	89	80	84	75	92	80	75	82	75	82	.....	.....	87	84
Oklahoma	80	83	68	81	70	78	73	82	67	.....	70	83	.....	.....	59	82
Arkansas	72	82	77	86	58	82	74	84	.....	.....	64	86	.....	.....	62	86
Montana	92	92	93	95	88	84	.....	.....	93	94	85	.....	.....	.....	90	92
Wyoming	95	93	91	92	65	79	.....	.....	90	.....	98	.....	.....	.....	95	94
Colorado	99	91	102	87	93	82	95	83	100	90	98	90	.....	.....	101	89
New Mexico	105	88	95	90	100	84	99	80	95	82	100	78	.....	.....	102	85
Arizona	.....	.....	92	94	95	.....	92	94	100	.....	100	89	.....	.....	94	88
Utah	99	96	89	88	100	90	.....	.....	100	.....	96	94	.....	.....	100	92
Nevada	100	96	100	93	100	.....	.....	.....	95	.....	.....	.....	.....	.....	102	94
Idaho	90	95	93	93	95	.....	.....	.....	94	94	92	89	.....	.....	92	96
Washington	91	93	95	94	90	.....	.....	.....	85	94	87	95	.....	.....	87	91
Oregon	95	93	96	93	90	96	.....	.....	96	92	73	94	.....	.....	90	91
California	98	92	98	94	.....	.....	98	90	97	87	95	90	.....	.....	97	87
United States	77.3	84.4	90.8	87.8	79.4	78.8	84.4	81.3	.....	.....	.....	.....	.....	.....	76.2	83.5

TABLE 20.—*Fruits: Condition, Aug. 1, 1914, with comparisons.*

State.	Apples.		Peaches.		Grapes.		Pears.		Watermelons.		Cantaloupes.		Tomatoes.		Blackberries.		Raspberries.	
	Condition, Aug. 1.														Production.[1]			
	1914.	10-yr. aver.	1914.	10-yr. aver.	1914.	10-yr. aver.	1914.	6-yr. aver.	1914.	8-yr. aver.	1914.	8-yr. aver.	1914.	8-yr. aver.	1914.	8-yr. aver.	1914.	8-yr. aver.
	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.
Maine	79	67	100	....	....	88	78	75	93	....	91	....	92	90	93	91	97	88
New Hampshire	78	64	15	72	78	83	61	76	98	....	73	....	90	87	98	88	95	84
Vermont	75	67	37	....	85	82	60	65	70	....	65	86	91	91	93	90	95	86
Massachusetts	79	67	20	60	93	86	75	74	90	83	90	84	95	86	91	87	93	84
Rhode Island	79	67	58	61	90	84	78	78	80	....	80	86	93	88	82	90	81	84
Connecticut	75	70	42	67	87	84	69	77	87	73	88	84	90	89	90	89	88	86
New York	69	60	20	58	81	83	50	67	84	82	83	80	90	86	83	82	84	81
New Jersey	86	58	89	58	95	83	76	62	81	80	82	80	87	85	85	78	84	76
Pennsylvania	77	58	63	50	88	78	70	62	83	78	84	79	90	84	83	80	87	78
Delaware	80	62	67	48	95	82	42	52	84	77	85	79	79	84	84	78	80	75
Maryland	78	59	78	53	92	78	72	58	84	75	83	75	82	80	82	79	84	78
Virginia	75	52	58	46	86	77	54	51	75	74	75	75	75	84	81	84	72	79
West Virginia	80	49	65	45	81	70	55	45	77	75	71	77	80	86	77	76	77	77
North Carolina	76	56	77	53	89	80	65	52	80	74	79	75	78	84	85	87	80	83
South Carolina	70	55	76	60	84	79	59	59	78	76	75	75	67	84	71	85	65	84
Georgia	75	54	86	62	84	81	64	57	80	81	76	76	72	86	72	88	69	89
Florida	....	....	75	70	....	....	67	57	74	82	68	75	77	....	....	....	....	....
Ohio	55	45	50	42	88	78	55	56	75	76	76	78	80	87	59	78	67	74
Indiana	39	48	45	45	83	81	47	54	66	77	67	78	65	82	52	75	55	74
Illinois	33	44	50	41	75	79	47	44	57	77	59	77	56	82	49	72	53	70
Michigan	67	56	45	53	91	79	71	62	85	79	87	81	90	84	84	80	86	78
Wisconsin	54	61	88	....	88	81	78	64	91	80	92	78	93	84	88	79	87	78
Minnesota	48	65	100	....	87	81	75	....	80	74	78	79	88	83	88	78	87	76
Iowa	24	52	55	31	84	77	46	38	81	78	82	80	86	84	65	73	75	69
Missouri	53	46	54	40	70	74	51	38	61	71	62	71	60	79	50	68	55	63
North Dakota	90	....	75	....	95	....	50	....	70	66	75	....	85	76	70	....	80	....
South Dakota	50	68	75	....	74	80	....	....	78	77	77	78	80	78	51	....	73	76
Nebraska	45	54	37	37	72	73	59	47	76	71	75	72	80	76	56	67	60	66
Kansas	50	47	55	40	65	70	63	45	78	70	79	71	72	74	66	64	64	62
Kentucky	58	52	66	48	78	77	58	50	64	73	62	74	63	84	63	81	65	75
Tennessee	62	51	62	48	75	71	51	44	66	75	66	76	66	85	68	87	70	78
Alabama	59	52	62	56	78	75	51	53	73	78	74	74	66	84	66	88	62	86
Mississippi	53	52	55	57	74	73	60	52	73	77	75	74	65	84	74	86	70	80
Louisiana	60	57	41	61	90	78	60	62	78	80	77	78	66	83	75	83	80	86
Texas	60	61	21	59	63	75	47	59	70	77	71	76	68	76	75	75	75	72
Oklahoma	51	61	10	55	57	71	30	50	63	72	67	72	53	70	58	68	57	60
Arkansas	65	58	44	62	72	74	55	48	65	75	64	76	59	82	56	80	58	77
Montana	75	79	88	....	100	....	62	75	82	78	81	78	85	86	100	....	105	86
Wyoming	90	70	100	....	75	....	50	....	75	....	75	....	91	88	100	....	97	....
Colorado	88	66	95	53	93	72	87	58	92	82	90	83	96	84	100	82	100	83
New Mexico	87	66	70	52	85	72	78	64	90	81	90	80	91	79	87	....	91	....
Arizona	80	72	80	63	90	84	85	77	93	92	94	91	90	87	100	....	100	....
Utah	95	74	97	66	97	84	85	67	93	88	94	86	96	76	97	92	97	89
Nevada	75	59	75	59	98	71	80	....	98	....	99	....	88	81	102	....	101	....
Idaho	77	79	70	62	70	85	68	74	71	88	75	88	84	84	75	91	77	93
Washington	84	78	65	72	88	88	78	79	83	87	82	86	81	83	94	92	92	93
Oregon	75	78	75	70	88	89	75	75	86	84	89	87	87	88	95	93	94	93
California	85	78	87	74	92	90	84	79	93	87	95	88	93	91	96	93	94	91
United States	61.3	54.3	55.9	54.3	88.4	84.4	60.9	61.1	73.2	76.7	78.4	77.5	77.7	83.1	70.8	77.5	80.5	76.9

[1] Per cent of full crop.

TABLE 21.—*Apples: Forecast of production, 1914, from condition, Aug. 1, estimated production, 1910–13, and prices, 1910–13.*

State.	Estimated production, bushels, 000 omitted.					Price to producer: Mean of September, October, and November averages.			
	1914	1913	1912	1911	1910	1913	1912	1911	1910
Maine	5,500	3,000	5,400	6,800	3,550	90	55	53	68
New Hampshire	1,700	800	2,200	1,600	1,800	105	62	66	66
Vermont	2,500	700	2,600	2,250	2,700	108	66	75	81
Massachusetts	3,000	2,300	3,300	3,000	2,900	116	76	95	79
Rhode Island	300	300	300	400	300	101	91	73	80
Connecticut	1,800	2,100	1,700	2,400	1,800	76	74	70	80
New York	36,000	19,500	44,000	39,000	17,000	85	48	56	81
New Jersey	3,000	2,100	1,700	3,100	1,700	70	66	58	72
Pennsylvania	19,500	10,200	12,700	20,500	11,600	81	61	52	64
N. Atlantic	73,300	41,000	73,900	79,050	43,350				
Delaware	400	180	420	300	350	85	65	67	42
Maryland	3,300	1,300	2,650	2,600	2,700	92	57	47	50
Virginia	12,300	5,200	15,000	7,200	12,100	73	47	65	59
West Virginia	10,300	1,000	10,300	7,800	7,100	113	47	67	60
North Carolina	7,200	3,000	7,600	3,600	7,200	84	69	79	72
South Carolina	700	260	600	470	740	127	99	124	93
Georgia	1,700	900	1,400	800	1,400	99	92	105	92
Florida									
S. Atlantic	35,900	11,840	37,970	22,770	31,590				
Ohio	10,500	4,800	10,600	18,700	5,900	100	59	50	82
Indiana	4,000	6,600	4,200	8,900	4,900	68	68	58	72
Illinois	4,100	8,200	5,800	10,600	800	69	70	51	100
Michigan	13,100	8,900	17,200	12,300	4,200	63	47	55	88
Wisconsin	2,500	4,000	2,000	3,000	400	68	78	72	106
N.C.E. Miss. R.	34,200	32,500	39,800	53,500	16,200				
Minnesota	900	1,800	700	1,300	150	73	102	87	146
Iowa	2,500	7,100	1,500	9,500	200	82	92	60	129
Missouri	11,700	7,900	19,200	11,600	7,600	74	46	61	68
North Dakota									
South Dakota	200	320	200	240	30	116	99	106	136
Nebraska	2,200	2,300	2,800	3,600	1,400	93	81	79	97
Kansas	4,200	2,700	6,700	2,400	6,600	105	60	89	65
N.C.W. Miss. R.	21,700	22,120	31,100	28,640	15,980				
Kentucky	7,100	6,900	9,600	6,100	5,300	76	64	81	76
Tennessee	5,900	3,900	8,900	2,900	5,200	93	64	93	70
Alabama	1,200	900	1,200	700	1,000	97	85	95	86
Mississippi	400	370	450	240	330	100	92	116	100
Louisiana									
Texas	400	300	500	200	400	120	98	118	118
Oklahoma	1,200	1,100	1,700	1,050	1,200	108	84	107	97
Arkansas	4,000	4,000	5,100	3,000	2,700	87	81	94	84
S. Central	20,200	17,470	27,450	14,190	16,130				
Montana	900	840	900	900	420	115	87	116	117
Wyoming		30	30	20	10				
Colorado	4,400	3,300	3,100	2,700	1,500	97	89	97	112
New Mexico	900	650	750	680	340	115	103	97	125
Arizona	100	90	130	110	100	202	200	208	188
Utah	800	610	680	460	410	85	82	96	126
Nevada	200	160	260	100	160	162	115	139	169
Idaho	1,500	1,400	1,650	1,200	1,250	95	82	106	98
Washington	7,600	6,900	7,700	3,500	5,800	91	67	96	78
Oregon	3,300	3,500	4,100	1,500	3,800	81	67	108	85
California	5,300	3,000	5,700	4,700	4,600	102	75	84	86
Far Western	25,000	20,480	25,000	15,870	18,390				
United States	210,300	145,410	235,220	214,020	141,640	85.5	62.3	69.7	80.1

TABLE 22.—*Vegetables and miscellaneous: Condition, Aug. 1, 1914, with comparisons.*

State.	Cabbages.		Onions.		Beans (dry).		Lima beans.		Broom corn.		Sugar cane.		Sorghum.		Sugar beets.		Hops.		Peanuts.	
	Condition, Aug. 1.																			
	1914.	8-year average.	1914.	8-year average.	1914.	8-year average.	1914.	7-year average.	1914.	8-year average.	1914.	10-year average.	1914.	10-year average.	1914.	8-year average.	1914.	10-year average.	1914.	8-year average.
	P.c.	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*
Maine	91	89	90	87	94	89	94	92	....	....	....	....	....	....	....	....	....	....	....	....
New Hampshire	90	86	92	86	95	89	....	87	....	....	....	....	....	....	....	....	....	....	....	....
Vermont	86	90	80	90	92	90	99	90	....	....	....	....	....	....	....	....	....	....	....	....
Massachusetts	91	86	92	84	92	87	93	85	....	....	....	....	....	....	....	....	....	....	....	....
Rhode Island	95	87	87	85	94	89	95	87	....	....	....	....	....	....	....	....	....	....	....	....
Connecticut	84	88	89	87	85	87	91	86	....	....	....	....	....	....	....	....	....	....	....	....
New York	87	84	86	86	90	87	89	85	....	....	....	....	....	....	....	....	85	85	....	....
New Jersey	87	85	78	85	85	86	86	83	....	....	....	....	....	....	....	....	....	....	....	....
Pennsylvania	90	85	86	88	90	85	90	84	....	....	....	....	....	....	....	....	....	....	....	....
Delaware	78	84	85	87	70	78	88	82	....	....	....	....	....	....	....	....	....	....	....	....
Maryland	80	78	84	85	84	79	85	80	....	....	....	....	....	....	....	....	....	....	....	....
Virginia	68	84	75	89	62	82	74	83	70	83	....	....	75	83	....	....	....	....	89	80
West Virginia	76	88	75	90	77	86	75	86	....	82	....	....	74	85	....	....	....	....	....	....
North Carolina	68	83	76	89	70	85	74	85	....	....	....	....	80	85	....	....	....	....	83	84
South Carolina	62	83	68	87	65	84	60	82	....	....	82	84	75	85	....	....	....	....	78	83
Georgia	63	85	73	89	70	84	66	88	....	....	80	86	80	88	....	....	....	....	82	88
Florida	82	....	....	....	....	....	....	....	....	....	81	86	86	82	....	....	....	....	87	89
Ohio	75	88	80	88	74	87	82	87	74	84	....	....	78	85	80	86	....	....	....	....
Indiana	59	82	72	86	65	82	61	83	67	....	....	....	61	81	....	....	....	....	....	....
Illinois	48	80	60	84	55	80	51	82	68	80	....	....	57	80	97	89	....	....	....	....
Michigan	89	83	89	83	88	87	89	82	....	....	....	....	....	....	92	87	....	....	....	....
Wisconsin	92	82	93	85	95	86	98	85	....	....	....	....	92	83	95	87	100	87	....	....
Minnesota	84	84	88	86	90	86	92	85	....	....	....	....	96	85	89	86	....	....	....	....
Iowa	77	82	86	85	82	83	81	84	79	88	....	....	88	84	93	90	....	....	....	....
Missouri	47	75	66	82	50	78	51	77	66	76	....	....	66	81	....	....	....	....	....	....
North Dakota	88	78	89	80	91	80	76	....	....	....	....	....	....	....	....	....	....	....	....	....
South Dakota	75	79	80	82	75	83	78	....	....	....	....	....	87	88	....	....	....	....	....	....
Nebraska	76	74	80	79	78	82	75	78	91	80	....	....	88	83	94	88	....	....	....	....
Kansas	64	71	82	78	83	74	75	73	83	75	....	....	89	81	90	82	....	....	....	....
Kentucky	52	84	73	89	54	82	53	83	64	78	....	....	66	82	77	....	....	....	55	....
Tennessee	58	85	73	90	56	84	55	83	67	83	....	....	70	85	....	....	....	....	56	83
Alabama	59	82	73	88	60	84	60	86	70	83	72	88	73	85	....	....	....	....	79	89
Mississippi	53	80	70	88	58	86	55	85	59	81	74	87	70	83	....	....	....	....	79	86
Louisiana	55	78	75	84	90	85	73	84	95	83	75	89	78	87	....	....	....	....	84	88
Texas	65	72	76	80	77	77	72	77	88	76	76	83	85	81	....	....	....	....	75	81
Oklahoma	43	65	74	79	70	73	65	69	75	75	....	....	70	83	....	....	....	....	66	77
Arkansas	49	76	75	86	65	80	60	77	60	82	70	86	65	85	70	....	....	....	68	83
Montana	89	89	88	88	86	92	90	....	....	....	....	....	....	....	92	94	....	....	....	....
Wyoming	92	90	92	92	92	91	71	....	....	....	....	....	....	....	95	95	....	....	....	....
Colorado	94	88	94	89	97	87	94	89	95	82	....	....	95	84	95	90	....	....	90	....
New Mexico	93	84	93	86	98	84	100	....	96	....	....	....	98	85	95	85	....	....	80	73
Arizona	90	88	90	90	92	87	93	....	....	....	....	....	96	87	91	92	....	....	....	84
Utah	96	92	98	93	95	90	93	90	....	....	....	....	98	92	99	94	....	....	....	....
Nevada	92	90	93	91	102	....	100	....	....	....	....	....	....	....	88	....	....	....	....	....
Idaho	89	91	93	93	84	90	86	91	....	....	....	....	....	....	95	94	....	....	....	....
Washington	87	88	90	90	83	91	88	90	....	....	....	....	....	....	90	94	93	92	....	....
Oregon	89	92	94	92	85	91	88	92	....	....	....	....	....	....	....	93	92	89	....	....
California	92	91	94	93	94	89	95	91	....	....	....	....	....	....	90	90	90	93	97	90
United States	79.3	83.3	80.6	86.3	88.5	86.9	76.3	83.9	76.1	76.1	75.5	88.5	74.1	83.3	92.4	89.4	89.8	89.8	82.6	85.1

TABLE 23.—*Prices paid to producers of farm products, by States.*

State.	July 15, 1914. Hogs. 1914	Hogs. 4-year average.	Beef cattle. 1914	Beef cattle. 4-year average.	Sheep. 1914	Sheep. 4-year average.	Milch cows. 1914	Milch cows. 4-year average.	Horses. 1914	Horses. 4-year average.	Aug. 1, 1914. Butter. 1914	Butter. 5-year average.	Eggs. 1914	Eggs. 5-year average.	Chickens. 1914	Chickens. 5-year average.
	Dollars.		*Dollars.*		*Dollars.*		*Dollars.*		*Dollars.*		*Cents.*		*Cents.*		*Cents.*	
Maine	7.50	7.25	7.50	6.75	4.00	4.48	52.00	48.78	209	206	30	28	23	25	15.9	15.8
New Hampshire	8.30	7.92	7.90	6.65	6.50	4.93	62.00	51.25	155	177	32	30	27	27	16.0	14.9
Vermont	7.70	7.02	6.00	4.95	4.30	3.78	57.00	47.40	179	160	29	28	23	24	14.0	13.5
Massachusetts	9.20	9.30	7.50	6.33	....	....	70.00	51.00	220	187	35	33	35	31	18.5	17.3
Rhode Island	9.60	8.50	7.70	7.67	5.10	....	75.00	61.67	....	....	34	32	30	32	21.0	17.0
Connecticut	10.30	8.67	9.00	8.30	9.00	....	68.70	59.17	220	211	34	33	30	30	18.0	16.7
New York	8.00	7.35	6.20	5.28	4.50	4.08	66.00	54.15	171	176	28	28	25	25	16.2	15.3
New Jersey	8.30	8.18	7.20	6.65	....	5.22	72.50	61.40	200	174	33	32	28	27	18.9	17.4
Pennsylvania	8.30	7.70	7.50	6.30	5.40	4.78	63.60	48.70	175	175	27	27	23	22	15.6	13.9
Delaware	8.00	8.17	6.50	5.20	5.30	4.93	56.00	41.90	142	134	30	26	26	21	19.0	13.4
Maryland	8.00	7.92	7.00	5.60	....	5.20	50.00	38.82	135	145	31	24	20	19	16.6	15.5
Virginia	7.70	7.00	6.30	4.90	3.90	3.90	48.00	37.85	145	144	23	22	18	17	15.2	14.3
West Virginia	7.90	7.35	6.50	5.15	4.30	4.00	52.70	42.20	139	145	23	21	19	19	13.9	12.8
North Carolina	8.20	7.55	5.20	4.12	5.00	4.12	40.00	33.08	162	152	23	23	18	16	13.1	12.0
South Carolina	7.50	7.22	4.80	4.20	5.60	4.82	41.70	35.65	174	174	25	24	21	18	13.2	12.3
Georgia	8.00	7.05	4.80	3.85	4.00	4.17	38.30	32.82	167	160	24	23	18	17	14.4	12.7
Florida	7.10	6.65	5.50	4.52	6.00	4.47	47.70	38.72	148	148	33	31	25	22	17.0	14.4
Ohio	8.20	7.58	7.20	5.82	4.50	3.88	61.40	49.18	158	167	24	22	19	18	13.3	12.0
Indiana	8.20	7.55	6.90	5.45	4.10	3.70	55.50	46.08	142	153	22	21	17	17	12.4	11.4
Illinois	8.10	7.40	7.00	5.80	4.50	4.05	62.00	50.98	148	155	26	23	17	16	12.3	11.0
Michigan	7.80	7.20	6.80	5.18	4.70	4.28	62.00	46.65	175	174	24	23	20	19	12.8	11.4
Wisconsin	7.70	7.30	5.80	4.70	4.80	3.95	66.40	49.52	179	174	27	25	18	17	12.4	11.8
Minnesota	7.50	7.10	6.00	4.40	4.60	4.25	63.10	44.15	158	166	24	24	17	16	11.3	10.0
Iowa	8.00	7.32	7.70	5.95	4.50	4.35	65.00	49.45	154	164	25	24	16	15	11.5	10.3
Missouri	7.70	7.10	6.90	5.48	4.40	3.95	56.60	45.68	118	124	22	20	14	13	11.5	10.8
North Dakota	6.90	6.58	5.90	4.38	5.00	4.50	65.00	46.32	137	150	20	20	15	16	10.4	10.0
South Dakota	7.50	7.02	6.60	5.15	5.00	4.20	65.50	45.40	129	137	22	22	16	15	9.7	9.2
Nebraska	7.90	7.05	7.10	5.68	6.00	4.80	67.00	48.00	125	133	21	20	15	14	10.7	9.9
Kansas	7.90	7.15	7.00	5.55	5.30	4.45	61.60	47.20	117	128	21	21	15	13	10.4	9.4
Kentucky	7.60	7.10	6.50	4.85	3.70	3.48	52.00	39.08	125	130	20	19	15	14	12.9	11.6
Tennessee	7.30	6.70	5.80	4.25	3.80	3.50	47.50	37.10	137	146	18	18	14	14	12.6	11.3
Alabama	7.00	6.70	4.40	3.30	4.80	3.90	39.60	30.80	139	141	22	20	17	15	14.0	11.3
Mississippi	6.40	6.40	4.50	3.42	4.00	3.82	41.50	30.50	120	122	23	22	16	16	12.7	11.9
Louisiana	6.90	5.92	5.50	4.22	4.90	3.75	40.00	33.70	94	94	27	26	18	17	12.0	13.1
Texas	7.20	6.62	5.70	4.28	5.00	4.15	54.30	43.42	95	97	21	20	14	14	10.6	9.6
Oklahoma	7.30	6.92	5.70	4.40	5.10	4.20	55.50	42.28	98	106	20	20	13	13	9.9	9.2
Arkansas	6.20	5.82	4.90	3.70	3.30	3.70	43.00	31.42	100	112	22	20	15	15	12.2	10.2
Montana	7.50	7.52	6.90	5.58	5.00	5.98	78.10	56.58	125	139	27	30	23	27	13.3	14.9
Wyoming	7.20	7.20	7.30	5.12	5.80	4.92	80.00	56.50	91	113	28	29	23	25	13.5	15.0
Colorado	7.70	7.20	7.00	4.68	5.00	4.82	75.00	54.55	110	119	25	27	20	22	12.8	13.7
New Mexico	8.00	7.25	7.00	5.22	4.80	4.48	61.00	52.00	69	84	32	31	25	25	13.2	13.8
Arizona	7.50	7.47	6.20	5.27	3.80	4.03	90.00	62.50	122	137	34	34	29	31	17.0	16.9
Utah	7.00	6.98	6.10	5.20	5.20	5.42	66.00	47.15	121	114	30	29	21	20	14.4	13.0
Nevada	8.30	7.57	6.30	5.02	5.00	4.08	75.00	60.40	125	92	32	35	28	32	18.0	18.8
Idaho	7.10	7.28	6.00	5.28	4.30	4.72	76.00	57.32	130	143	25	28	21	24	11.8	12.1
Washington	7.30	7.72	6.30	5.60	4.50	4.55	78.00	61.40	125	147	28	30	25	26	13.7	13.8
Oregon	7.10	7.78	6.20	5.52	4.50	4.55	71.00	52.25	94	117	29	29	24	25	13.2	12.7
California	8.00	7.12	6.50	5.75	4.90	4.62	77.00	54.10	124	139	28	28	26	25	16.0	14.7
United States	7.72	7.13	6.38	5.07	4.75	4.52	59.67	46.38	136.97	143.09	23.7	23.3	18.2	17.4	12.8	11.7

TABLE 24.—*Averages for the United States of prices paid to producers of farm products.*

Products.	July 15.					Aug. 15.		June 15.		
	1914	1913	1912	1911	1910	1913	1912	1914	1913	1912
Hogs.........per 100 pounds..	$7.72	$7.81	$6.64	$5.92	$8.15	$7.79	$7.11	$7.43	$7.61	$6.65
Beef cattle.............do....	6.38	5.98	5.17	4.28	4.84	5.91	5.37	6.32	6.02	5.23
Veal calves.............do....	7.80	7.46	6.33	5.74	6.37	7.53	6.62	7.69	7.53	6.33
Sheep...................do....	4.75	4.20	4.21	4.19	5.47	4.32	4.26	4.70	4.84	4.52
Lambs...................do....	6.55	6.05	5.74	5.42	6.71	5.50	5.60	6.47	6.36	6.02
Milch cows.........per head..	59.67	54.80	45.41	42.44	42.86	54.78	46.11	59.82	55.20	45.84
Horses..................do....	137.00	143.00	142.00	139.00	148.00	141.00	142.00	136.00	146.00	145.00
Honey, comb.....per pound..	.135	.139	.139	.137	.131	.138	.137	.138	.139	.140
Wool, unwashed.......do....	.185	.159	.189	.154	.190	.158	.188	.184	.156	.187
Apples...........per bushel..	.91	.86	.82	.95	.77	.75	.68	1.36	1.01	1.08
Peaches.................do....	1.20	1.30	1.12	1.51	....	1.26	1.08	....	....	....
Tomatoes..............do....	1.67	1.61	1.27	....	....	.96	....	....	....	....
Peanuts..........per pound..	.052	.051	.049	.050	.052	.049	.050	.051	.050	.052
Beans............per bushel..	2.22	2.22	2.47	2.23	2.34	2.11	2.40	2.23	2.23	2.62
Sweet potatoes.........do....	.94	.89	1.13	1.04	.74	.99	1.02	.92	.91	1.11
Cabbages.....per 100 pounds..	2.66	2.64	2.29	2.93	2.27	2.15	1.88	2.61	2.18	2.67
Onions...........per bushel..	1.70	1.02	1.14	1.22	1.04	1.05	1.00	1.41	.96	1.55
Clover seed.............do....	8.12	9.78	10.64	8.83	7.17	9.37	9.80	7.96	9.77	11.69
Timothy seed..........do....	2.32	1.94	5.96	5.48	....	2.01	3.20	2.23	1.77	6.68
Alfalfa seed.............do....	6.92	8.20	8.32	....	....	7.96	8.58	6.83	8.08	8.47
Broom corn..........per ton..	88.00	57.00	85.00	68.00	180.00	91.00	83.00	88.00	61.00	79.00
Cotton seed ....do....	22.78	21.37	19.04	22.70	....	20.24	18.02	23.62	21.54	19.24
Hops.............per pound..	.147	.148	.289	.258	....	....	.188	....	.141	....
Paid by farmers:										
Clover seed...per bushel..	9.79	12.12	12.82	....	....	11.94	11.78	9.86	12.47	13.49
Timothy seed.......do....	2.99	2.57	6.59	....	....	2.76	3.89	2.98	2.44	7.37
Alfalfa seed.........do....	8.29	9.41	10.07	....	....	10.06	10.07	8.31	9.73	10.25
Bran............per ton..	26.36	24.65	28.41	25.80	25.22	25.10	27.41	27.75	24.67	29.35

TABLE 25.—*Range of prices of agricultural products at market centers.*

Product and market.	Aug. 1, 1914.	July, 1914.	June, 1914.	July, 1913.	July, 1912.
Wheat per bushel:					
No. 2 red winter, St. Louis..	$0.81 -$0.82	$0.76 -$0.91	$0.75¼-$0.97	$0.83 -$0.90	$0.98 -$1.15¼
No. 2 red winter, Chicago....	.87¾- .88½	.77¾- .95¼	.78¾- .96⅞	.84 - .96	.97½- 1.10¼
No. 2 red winter, New York[1].	.95½- .96½	.88½- 1.02½	.96¼- 1.10	.95¼- .98¾	1.06¾- 1.19¾
Corn per bushel:					
No. 2 mixed, St. Louis.......	.77½- .77½	.67 - .77½	.68½- .73½	.61¾- .66	.69½- .77½
No. 2, Chicago...............	.74 - .74½	.67½- .76	.68¼- .73½	.60 - .62½	.69½- .75
No. 2 mixed, New York[1]	....	....	....	....	.76¾- .84
Oats per bushel:					
No. 2, St. Louis..............	.35 - .35	.35 - .38½	.36½- .42½	.32 - .51	.32 - .51
No. 2, Chicago...............	.36½- .37	.34⅝- .39½	.36⅝- .40¾	.37½- .41⅞	.42 - .57
Rye per bushel: No. 2, Chicago...	.68 - .70	.55 - .72	.58 - .67	.61 - .64½	.71½- .76
Baled hay per ton: No. 1 timothy, Chicago..................	17.50 -18.50	14.50 -18.00	14.50 -16.00	13.50 -17.50	17.50 -22.00
Hops, per pound: Choice, New York..........................	.35 - .37	.35 - .38	.36 - .40	.17 - .21	.28 - .38
Wool per pound:					
Ohio fine unwashed, Boston.	.25 - .25	.24 - .25	.22 - .25	.20 - .21	.22 - .24
Best tub washed, St. Louis..	.32 - .33	.32 - .33	.30 - .33	.35 - .35	.35 - .35
Live hogs per 100 pounds: Bulk of sales, Chicago...............	8.40 - 8.80	8.50 - 9.50	7.80 - 8.40	8.75 - 9.40	7.40 - 8.20
Butter per pound:					
Creamery, extra, New York..	.29½- .30	.26¾- .29½	.26½- .28	.26 - .28½	.27 - .27¼
Creamery, extra, Elgin......	.28 - .28	.26 - .28	.26¼- .27½	.26 - .26½	.25 - .25½
Eggs per dozen:					
Average best fresh, New York	.27 - .32	.24 - .31	.22½- .28	.25 - .33	.23 - .31
Average best fresh, St. Louis.	.19 - .19	.18 - .19	.14 - .18	.14½- .17	.14½- .17
Cheese per pound: Colored,[2] New York..........................	.14½- .14½	.14 - .14½	.13½- .15	.13¾- .14	.14¾- .15¼

[1] F. o. b. afloat.
[2] September colored—September to April, inclusive; new colored May to July, inclusive; colored August.

TABLE 26.—*The equivalent in yield per acre of 100 per cent condition on Sept. 1 in each State.*

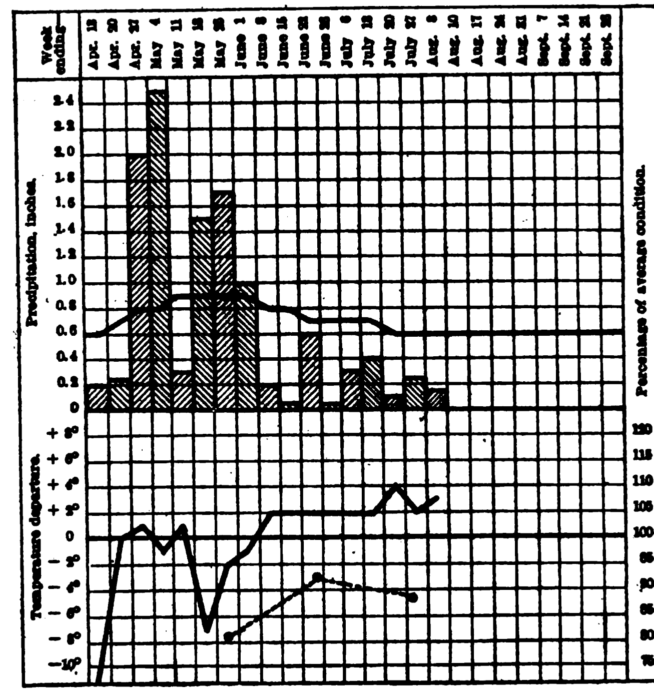
State.	Corn.	Spring wheat.	Oats.	Barley.	Buckwheat.	Potatoes.	Sweet potatoes.	Tobacco.	Flax.	Rice.	Cotton.
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Lbs.*	*Bu.*	*Bu.*	*Lbs.*
Maine	48.5	27.0	41.0	31.5	34.0	240					
New Hampshire	48.5		39.0	29.0	31.5	160		1,900			
Vermont	46.5	28.0	41.5	34.5	27.5	155		1,900			
Massachusetts	50.0		38.5		23.3	145		1,900			
Rhode Island	43.0		35.0			160					
Connecticut	51.0		38.0		21.7	140		1,900			
New York	45.0		37.5	31.0	26.5	123		1,470			
New Jersey	44.0		36.0		26.5	132	155				
Pennsylvania	49.0		36.3	29.5	24.5	120	134	1,650			
Delaware	39.0		36.0		22.5	122	145				
Maryland	42.0		33.8	33.0	21.5	119	144	900			
Virginia	30.6		25.0	30.0	22.0	108	119	900			275
West Virginia	37.0		28.0		26.0	117	128	940			
North Carolina	22.4		22.0		22.0	100	113	810		31.5	305
South Carolina	22.0		26.0			106	113	930		29.0	290
Georgia	17.5		24.0			94	102	900		33.0	250
Florida	16.0		20.0			110	123	950		30.0	155
Ohio	46.0		41.5	33.0	23.5	116	127	1,100			
Indiana	45.0		39.0	31.5	21.0	119	130	1,100			
Illinois	43.5		41.5	33.0	22.5	113	125	930			
Michigan	41.5		39.0	30.0	19.5	132					
Wisconsin	42.5	21.0	40.5	33.5	19.0	135		1,470	15.5		
Minnesota	40.0	18.0	41.0	31.0	20.3	132			11.7		
Iowa	44.0	19.0	39.0	31.5	19.5	125	124		12.4		
Missouri	38.0		35.0	28.5	19.0	105	120	1,200	9.6		360
North Dakota	32.0	16.0	36.5	28.5		122			10.8		
South Dakota	34.0	15.8	35.5	29.0		103			10.4		
Nebraska	35.5	17.3	36.0	29.5	22.0	102	115		10.1		
Kansas	31.5	18.5	36.5	29.0	17.5	97	120		9.1		
Kentucky	34.2		29.0	30.0		101	107	1,070			
Tennessee	30.5		26.0	29.5	19.0	94	105	930			245
Alabama	20.0		23.0			99	110	700		34.0	232
Mississippi	22.4		24.0			109	110			36.0	265
Louisiana	25.5		26.5			91	102	590		37.5	260
Texas	28.0		42.0	34.0		87	105	820		39.0	242
Oklahoma	30.0		39.0	34.0		96	123		13.0		255
Arkansas	26.0		30.0			98	114	840		43.0	254
Montana	33.5	28.0	50.5	37.5		175			11.7		
Wyoming	28.0	30.0	41.0	35.5		155					
Colorado	25.0	29.0	45.0	40.0		145			9.0		
New Mexico	31.0	25.5	41.0	37.0		115	180				
Arizona	36.0	28.0	45.0	41.0		119	150				
Utah	34.6	30.0	48.0	43.0		190					
Nevada	35.0	31.0	45.0	41.0		172					
Idaho	34.0	29.0	48.0	44.0		192					
Washington	32.0	24.0	54.0	43.0		180					
Oregon	32.0	22.0	40.5	38.5		150					
California	41.0		41.0	33.0		150	175			54.0	
United States	34.7	18.0	38.4	31.9	24.7	129.3	113.7	1,021	11.0	38.8	259.7

DIAGRAMS SHOWING WEEKLY WEATHER CONDITIONS AND THE PROGRESS OF CROPS IN THE PRINCIPAL COTTON, CORN, AND WHEAT REGIONS, FOR THE SEASON APRIL 6 TO DATE.

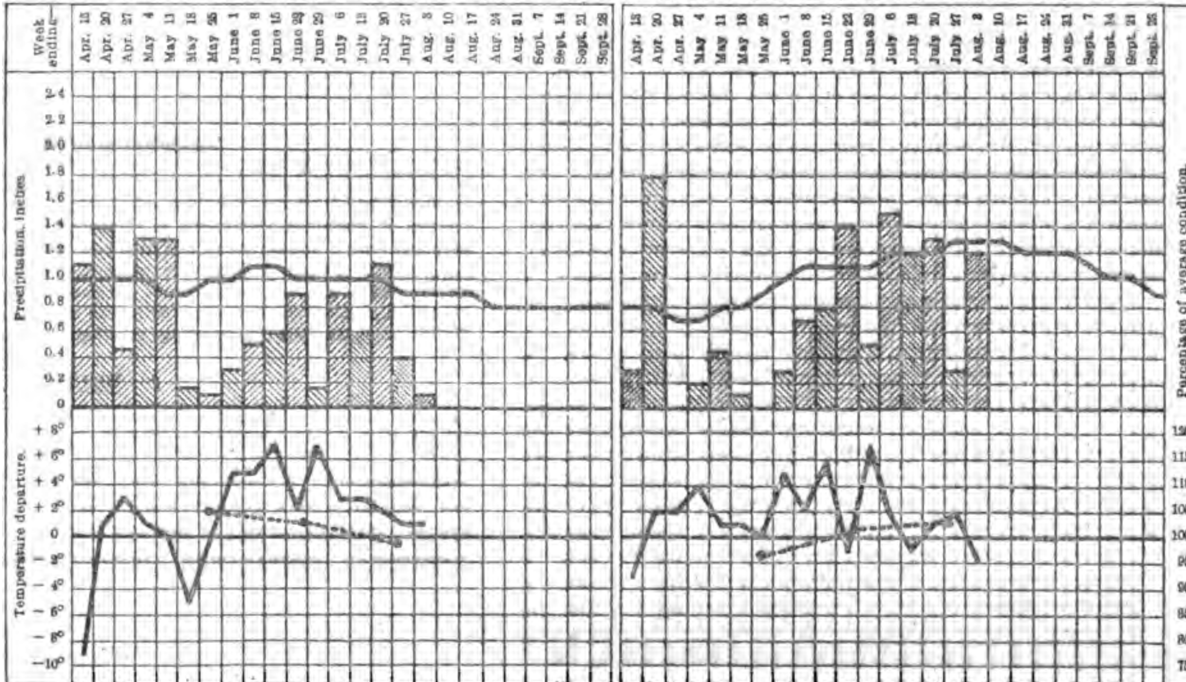
The diagrams shown on this and the following page indicate graphically by weeks the progress of the season's weather as compared with the normal in the several principal crop-growing districts, especially the cotton, and corn and wheat regions. They also show the percentage of the average condition by months, when available, of the corn, wheat, and cotton crops on the dates and for the States indicated on each chart, as reported by the Bureau of Crop Estimates, U. S. Department of Agriculture.

COTTON REGION.

Western Section: Texas and Oklahoma.



Central Section: Alabama, Mississippi, Louisiana, Arkansas, and Tennessee. Eastern Section: North Carolina, South Carolina, Georgia, and Florida.



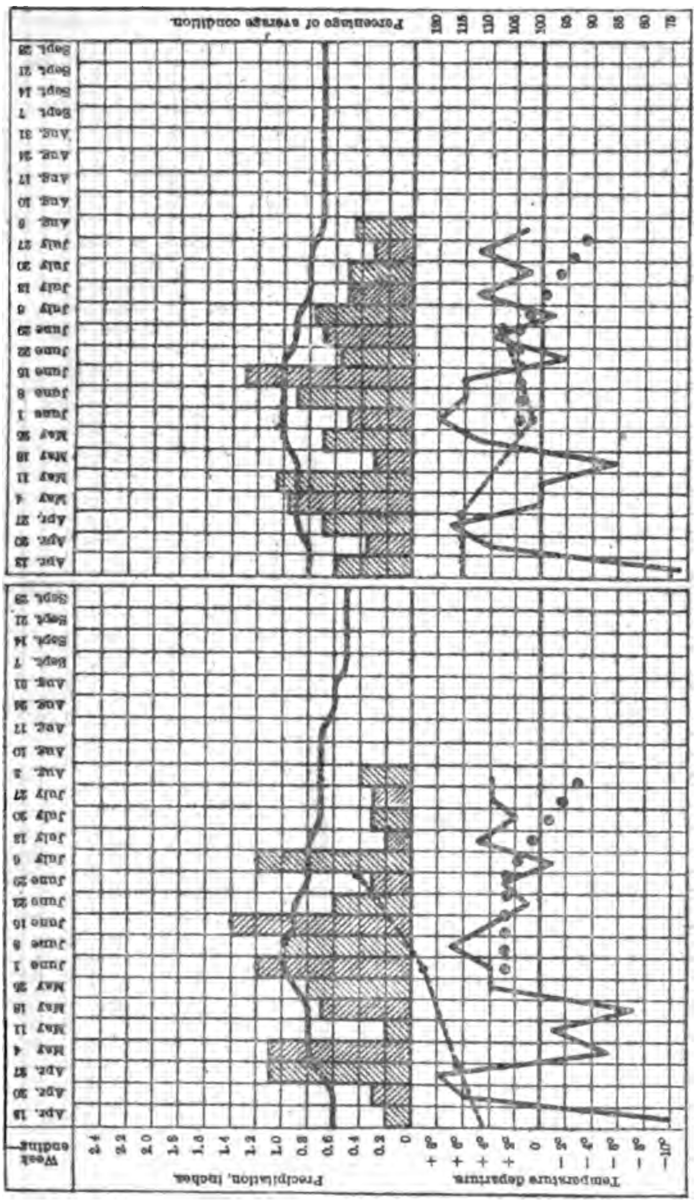
Shaded blocks in upper part of each diagram show average weekly precipitation as indicated by figures at left, and the heavy solid line indicates the normal weekly precipitation.

The weekly temperature departures from the normal are shown by the heavy black line in the lower part of each diagram, the amount of departures, in degrees, being indicated by the figures on the left. The percentage of the average condition of cotton on the dates indicated, is shown by the dotted line, the amounts above or below 100 per cent being indicated by the figures on the right.

CORN AND WHEAT REGIONS.

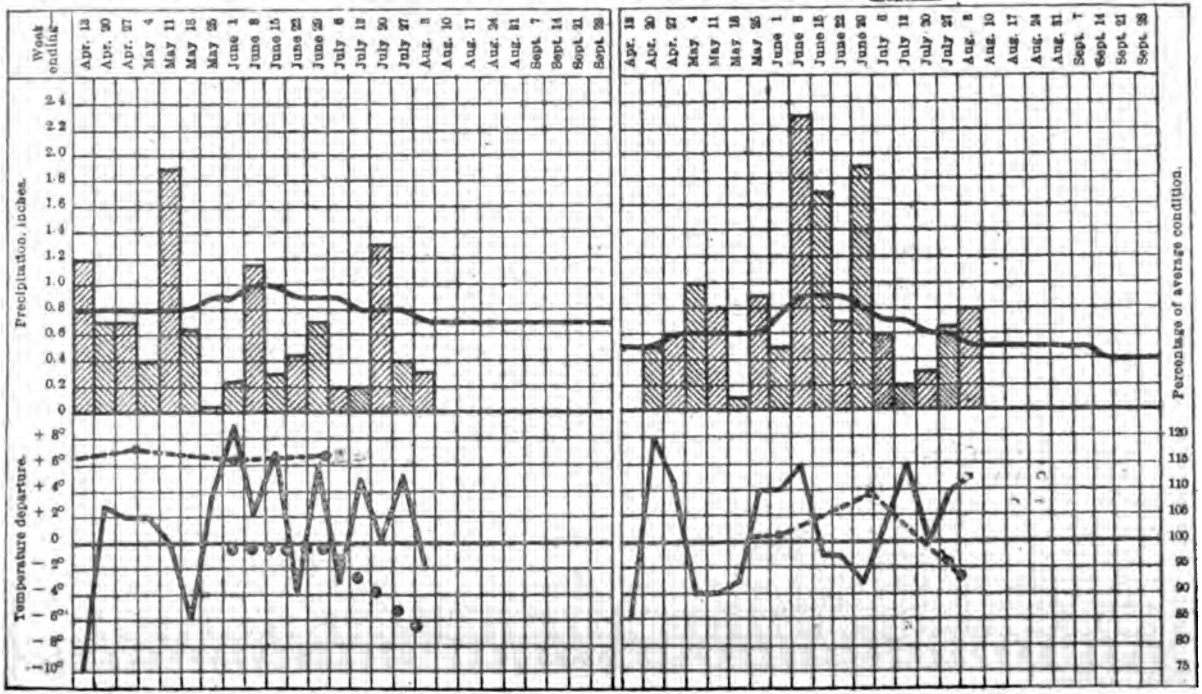
Western Section: South Dakota, Nebraska, Kansas, and Oklahoma.

Central Section: Wisconsin, Minnesota, Iowa, Illinois, Missouri, and Arkansas.



Eastern Section: Michigan, Ohio, Indiana, Kentucky, and Tennessee.

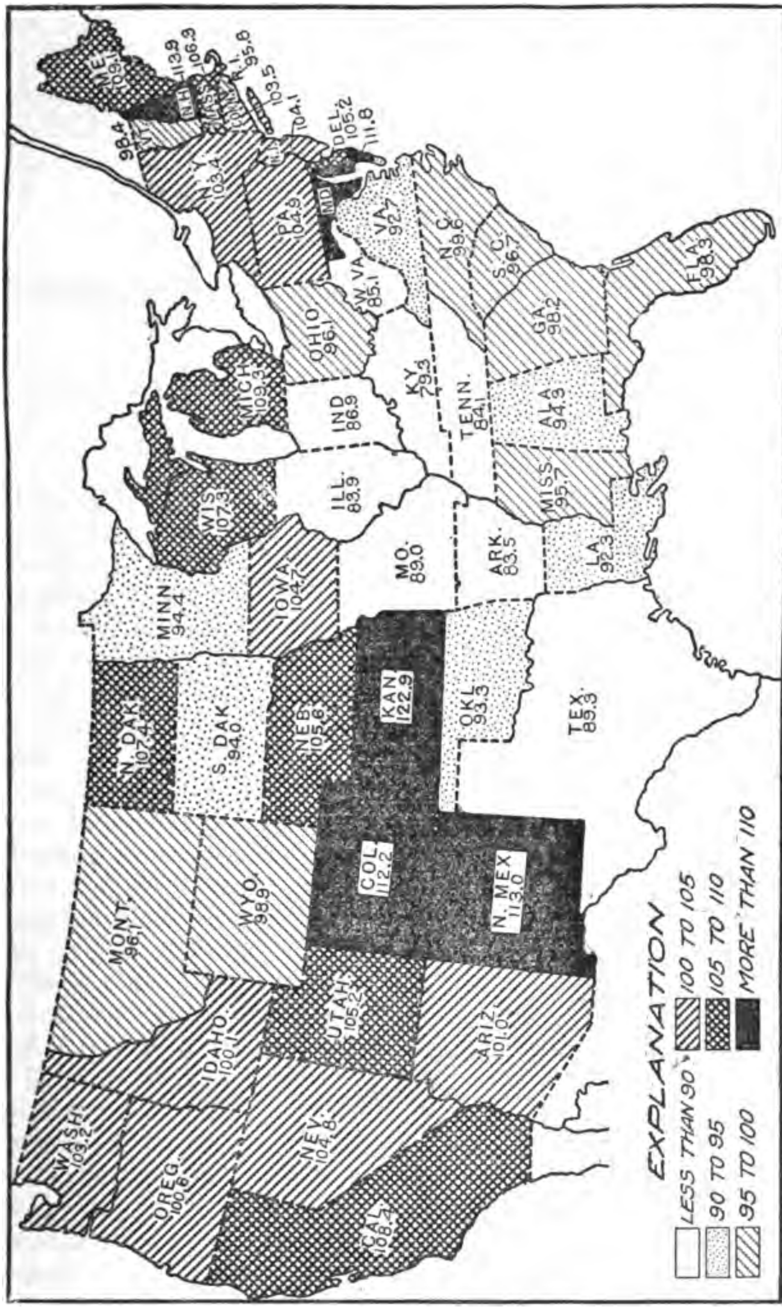
Spring wheat region: Minnesota, North Dakota, South Dakota, and Montana.



Shaded blocks in upper part of each diagram show average weekly precipitation as indicated by figures at left, and the heavy solid line indicates the normal weekly precipitation.

The weekly temperature departures from the normal are shown by the heavy black line in the lower part of each diagram, the amount of departures, in degrees, being indicated by the figures on the left. The percentage of the average condition of wheat on the dates indicated, is shown by the dotted line, the amounts above or below 100 per cent being indicated by the figures on the right.

●●●● Average condition of corn to August 1.



Crop conditions August 1, 1914: Composite of all crops (weighted), 100 representing the 10-year average (not normal) condition on August 1.

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WINTER-WHEAT VARIETIES FOR THE EASTERN UNITED STATES.

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INTRODUCTION.

This bulletin deals principally with the soft red and soft white winter wheats adapted to the eastern half of the United States. It is necessary, however, in discussing the kinds of wheat grown in certain of the States in this section to deal to some extent with the hard red winter wheats and the spring wheats, as there are districts in which these types of wheat may be grown along with the previously mentioned types. There are, in other words, transition zones between the different wheat-growing districts where either of two types of wheat may do about equally well.

Fig. 1.—Map of the United States, showing by shaded lines that portion of the humid wheat region in which winter wheat is now grown. The boundaries are somewhat arbitrary, there being transition zones on the north and west. The average annual rainfall in inches is shown by the numbered lines.

The section of the United States here under consideration (the shaded portion of fig. 1) comprises mainly the States east of Nebraska, Kansas, Oklahoma, and Texas and a small eastern portion of each of the States mentioned. In nearly all of this area the average annual rainfall is at least 30 inches, and, although large seasonal variations occur, the area is generally considered as humid. The average annual rainfall in inches is shown by the numbered lines in figure 1.

Note.—Of interest in the wheat-growing sections of the eastern United States.

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Many varieties of wheat are being grown at the present time by the farmers of this part of the United States, and new varieties are continually being originated and distributed by public or private agencies. The same variety is often known by two or more different names, however, and the actual number of distinct varieties is much smaller than the long list of varietal names would indicate. The number of distinct varieties, nevertheless, is large, although the characters which distinguish them are often minute and sometimes not related to the characters which make the varieties valuable. Careful study and considerable time are required in order to learn to recognize varieties, and comparative tests are necessary to determine their value.

TESTING VARIETIES.

The testing of varieties of wheat has always been an important work of the State agricultural experiment stations and the United States Department of Agriculture. In such tests usually a large number of varieties are grown under conditions as nearly alike as possible, for the purpose of determining the varieties best suited to local conditions.

It usually has been impossible, however, to find any one wheat which is always best for a given locality, as conditions of climate and soil cause fluctuations from season to season. About the best that can be hoped for is to determine several of the varieties which will do well on the average for several seasons. The variety which gives the best average yield is usually the one that should be grown, and not one that yields remarkably well, perhaps, in one season out of many, but whose average yield is low. The recommendations made are based principally upon the results set forth in publications by the State experiment stations.

NORTHWARD ADVANCE OF WINTER WHEAT.

Since the introduction of the hardy varieties of wheat from southeastern Europe there has been a decided northward movement of the winter-wheat area. This has been going on rapidly in recent years. The reasons therefor are the generally larger yields of winter wheat, due (1) to its earlier maturity, thus enabling it to escape hail, hot winds, disease, etc.; (2) to its greater drought resistance; and (3) to the better division of labor which it allows through fall seeding and earlier harvesting.

The acreage of winter wheat in 1909 is shown in figure 2 and the same data for common spring wheat in figure 3.

The average yields in Iowa for five years show an advantage of 4.8 bushels in favor of winter wheat over spring wheat. The results of a 4-year test in Minnesota show a similar advantage of 8.5

bushels. With this evidence at hand it is seen that the region in which winter wheat is grown should be extended northward as rapidly as possible, making use of the hardy varieties and more hardy strains as these are developed, and that the spring varieties should be used only in cases where the fall-sown wheats are winterkilled or where winter-wheat growing has been found by trial to be unprofitable. Large plantings of winter wheat should not be made in any locality, however, until it has been determined by tests lasting at least three years whether or not winter wheat will succeed.

TRANSITION ZONES IN WHEAT GROWING.

As has been stated, there is in northern Iowa and southern Minnesota a transition zone between the district which grows only winter

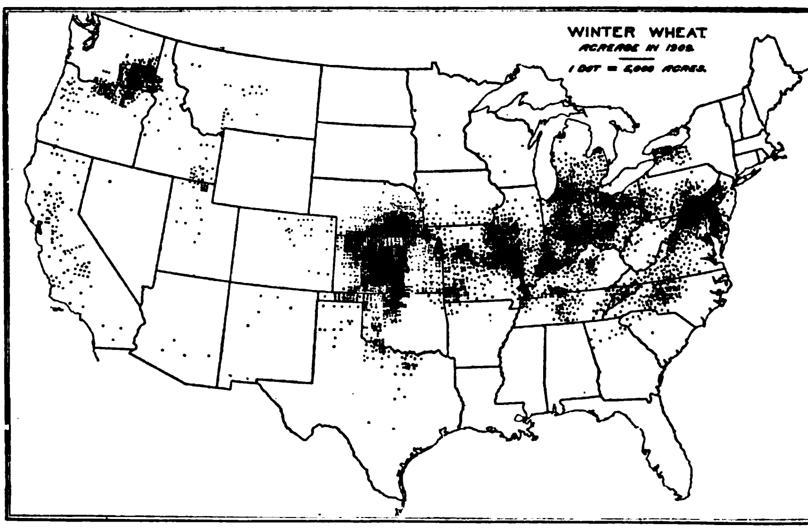

FIG. 2.—Map of the United States, showing the acreage of winter wheat grown in 1909. Each dot represents 5,000 acres. Each county having over 2,500 acres and not more than 7,500 acres has one dot, from 7,500 acres to 12,500 acres, two dots, etc.

wheat and the district which grows only spring wheat. In this zone both spring and winter wheats are grown, often on the same farm. This same condition exists in northeastern Nebraska.

In southern Iowa, southeastern Nebraska, eastern Kansas, central Oklahoma, and north-central Texas there is a similar transition zone, the two types of wheat being the hard red winter wheats of the Turkey type, that are better adapted westward, and the soft red winter wheats, that are better adapted eastward. This transition zone, generally speaking, is that region which has an average annual rainfall of about 30 to 35 inches.

HARD RED WINTER WHEAT.

The hard red winter wheats are of the Turkey or Crimean type, represented principally by the Turkey, Crimean, Kharkof, and Malakof varieties. All of these are usually adapted to localities in which the Turkey variety succeeds. The Kharkof is generally considered to be more hardy than the Turkey variety and consequently better adapted than the latter to northern localities, especially in the northern parts of Illinois, Iowa, and Nebraska and the southern parts of Minnesota and Wisconsin. Certain selected strains of the Turkey wheat seem to be, however, equally as hardy as the Kharkof. There

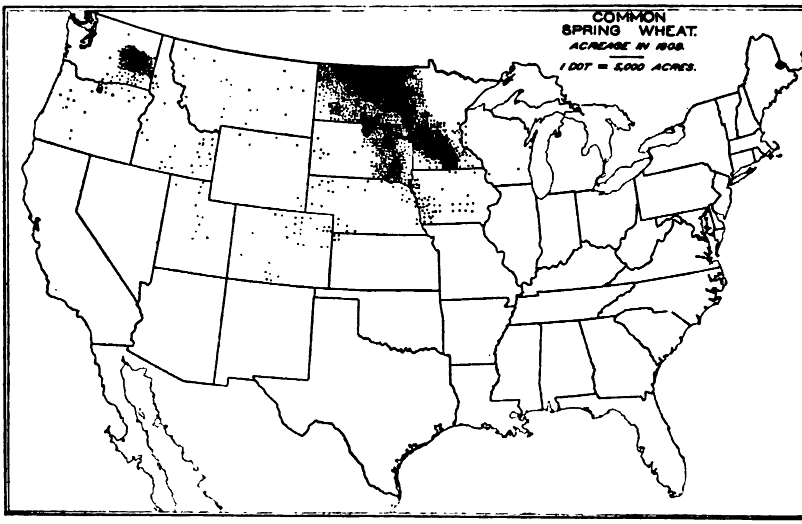

FIG. 3.—Map of the United States, showing the acreage of common spring wheat grown in 1909. Each dot represents 5,000 acres. Each county having over 2,500 acres and not more than 7,500 acres has one dot, from 7,500 acres to 12,500 acres, two dots, etc.

are also strains of these hard wheats, selected at several State experiment stations, which yield much better than the unselected seed commonly grown.

SOFT RED WINTER WHEAT.

Soft red winter wheat is grown in all that part of the United States where wheat is grown east and south of the transition zone already described, except those parts of the North Atlantic and New England States where white wheat or spring wheat is produced. This region is sometimes divided into northern and southern sections; but this division is based upon climatic conditions, since the grain produced in the Southern States is not markedly different from that produced in the Northern States.

For convenience of reference only, the States producing red winter wheat will be grouped under the following heads:

(1) The southern section west of the Mississippi River, which includes eastern Oklahoma, Arkansas, Texas, and Louisiana.

(2) The southern section east of the Mississippi River, which includes Tennessee and North Carolina and the States southward.

(3) The North-Central States, which include Kentucky and the States northward; also Missouri and part of Kansas.

(4) The North Atlantic States, which include Virginia and the States northward.

FIG. 4.—Heads of bearded winter wheat, representative of the following groups: 1, Mediterranean (group 6); 2, Virginia (group 7); 3, Bearded Winter Fife (group 13); 4, Early Genesee Giant (group 12).

ADAPTED VARIETIES OF SOFT RED WINTER WHEAT.

THE SOUTHERN SECTION WEST OF THE MISSISSIPPI RIVER.

Texas.—For the northern part of Texas, extending southward three or four tiers of counties from the Red River, where the annual rainfall amounts to about 30 inches or more, bearded wheats of the

Mediterranean type (fig. 4) are commonly grown and give on the average better results than the Turkey wheats. In addition to the Mediterranean variety, the Fulcaster and the Ironclad are varieties of soft red bearded wheats commonly grown, while the Poole, Michigan Amber, and German Emperor (all very similar to each other) are good soft red beardless wheats. The area to the west, where the rainfall is less than about 30 inches annually, is included in the hard winter-wheat district, and the Turkey and Kharkof varieties are more certain of giving a good crop. Wheat is not successfully grown on the sandy coastal plains of Texas.

Oklahoma.—Sibley New Golden, Missouri Bluestem, Fulcaster, and Mediterranean (bearded varieties), and Early Red Clawson, New Red Wonder, Red Russian, and Fultz (beardless varieties) are adapted to eastern and southern Oklahoma, where the annual rainfall amounts to about 30 inches or more.

Louisiana.—Wheat has generally failed when grown for grain in Louisiana, and it can not without reservation be recommended as a crop to farmers. On the red lands of northern Louisiana, however, wheat is one of the best winter grazing crops and in favorable seasons may produce a profitable yield of grain. As it fits well in systematic rotations, wheat may often be profitably grown in Louisiana for pasture, feed, and building up the land. The following varieties of soft red winter wheat are reported as having yielded well: Fultz, Red May, Harvest King, Fulcaster, and Purple Straw. Of these varieties the Fulcaster is bearded, while the others are beardless.

Arkansas.—Conditions for wheat growing in southern Arkansas are similar to those of northern Louisiana. On the high lands of the northern part, however, wheat may be more successfully grown. The varieties giving the best results are Kentucky Bluestem, Red May, Fultz, Fulcaster, and Sibley New Golden.

THE SOUTHERN SECTION EAST OF THE MISSISSIPPI RIVER.

Mississippi, Alabama, Georgia, and South Carolina.—The Purple Straw, Bluestem (Alabama Bluestem or Georgia Bluestem), Alabama Red, Georgia Red, Fultz, and Red May (beardless varieties) and the Fulcaster (a bearded variety) seem to be the best for general sowing in the central and northern parts of Mississippi, Alabama, Georgia, and South Carolina. Wheat is more successfully grown on clay or loam than on sandy soil; consequently it is not often grown in the southern parts of those States, but its growing is principally confined to the Piedmont region.

Florida.—Wheat is not successfully grown in Florida.

Tennessee.—Much of Tennessee is rather well suited to wheat growing, the yields and the quality of grain being good. The Poole, Fulcaster, and Mediterranean varieties are recommended. All produce flour of excellent quality. The Poole is beardless, while the other two are bearded. The Nigger and the Kansas Mortgage Lifter are other bearded varieties that yield well.

North Carolina.—The Piedmont and mountain sections of North Carolina are suited to wheat growing. The Purple Straw, Golden Chaff, Harvest King, Red May, Currell Prolific, and Fultz (beard-

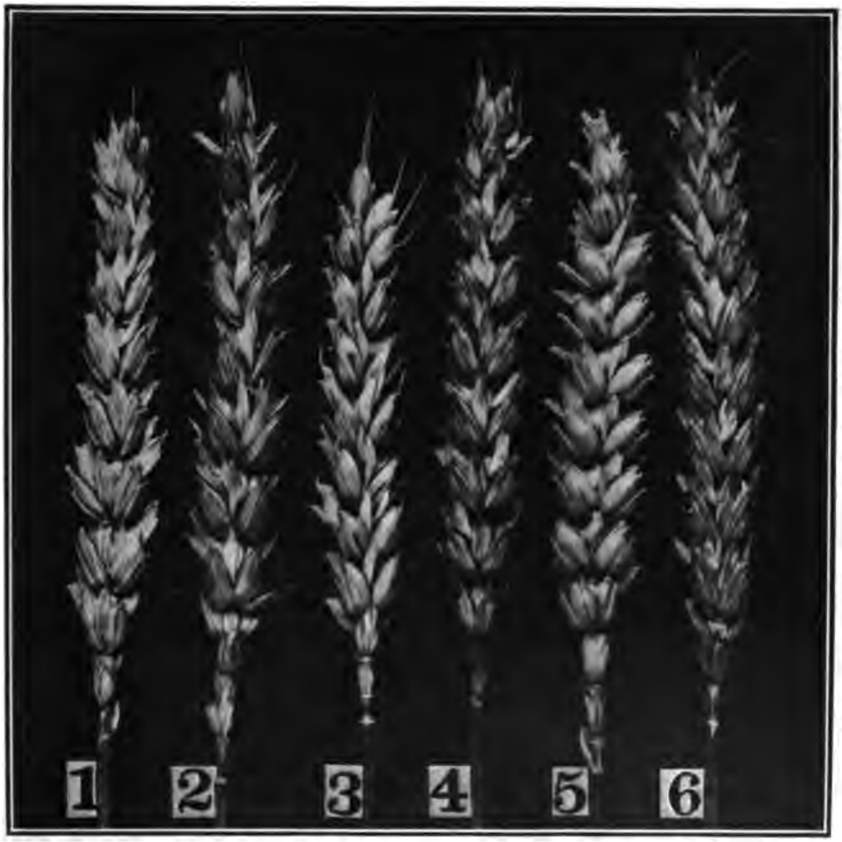

FIG. 5.—Heads of beardless winter wheat, representative of the following groups: 1, Fultz (group 1); 2, Leap Prolific (group 1); 3, Purple Straw (group 1); 4, Poole (group 2); 5, Mealy (group 3); 6, Dawson Golden Chaff (group 10).

less varieties, fig. 5), and the Fulcaster, Lancaster, Dietz, and Red Wonder (bearded varieties) are some of the well-known sorts which have given good yields in this State.

THE NORTH-CENTRAL STATES.

Eastern Kansas.—For eastern and southeastern Kansas it has been found that the Zimmerman, Fulcaster, Mediterranean, Fultz, Currell Prolific, Harvest Queen, and similar varieties are best adapted. The Harvest Queen is the best wheat tried thus far in the locality of Leavenworth. It is a good yielder, has a stiff straw, and stands up well on rich soil. The Zimmerman succeeds well in the northern and northeastern counties. The other varieties mentioned are better adapted to the eastern and southeastern parts of the State. The Fulcaster and the Mediterranean are the only bearded varieties mentioned. These soft or semihard wheats seem to be the best for growing in that section of Kansas in which the average annual rainfall amounts to more than 35 inches. This includes the first eastern tier of counties on the north and, gradually increasing toward the south, includes the three eastern tiers on the southern border. The section of the State between the lines of 35 and 30 inch rainfall, including the third tier of counties from the east on the north and the fourth and fifth tiers on the south, are probably in the transition zone between the soft and hard wheats.

Missouri.—Extensive varietal tests made at the Missouri Agricultural Experiment Station indicate that the Dietz, Rudy, Mediterranean, Fulcaster, and Lebanon (bearded varieties), and the Poole, Michigan Wonder, Red Wave, Hickman, Beechwood Hybrid, Early Ripe, and Fultz (beardless varieties) are well adapted to conditions in central Missouri. The hard red wheats are worthy of trial in the northwestern corner of the State.

Illinois.—The hard red wheats are best adapted to central and northern Illinois. The Kharkof seems best adapted to the extreme northern part, while the Kharkof, Turkey, Malakof, and Beloglina are all adapted to the remainder of this section.

The soft red wheats are best adapted to southern Illinois. These varieties are among the best for this part of the State: Fulcaster and Rudy (bearded varieties), and Harvest King, Wheedling, Fultz, and Poole (beardless varieties).

Kentucky.—The Jersey Fultz is recommended as the best variety that has been found for the vicinity of Lexington and similar localities in Kentucky. The Extra Early Oakley is also good. These are both beardless wheats very similar in appearance. The Harvest King is another good beardless wheat. Among the bearded wheats the Kansas Mortgage Lifter, Fulcaster, and Lancaster are especially recommended. The Fulcaster is perhaps the best milling wheat among all these varieties (fig. 6).

Indiana.—Cooperative tests made with a number of good varieties throughout the State of Indiana for four years indicate that the Michigan Amber, Dawson Golden Chaff (grains white or amber), and the Rudy yield well throughout this State and have good milling value. The Egyptian Amber and the Farmers Friend have likewise shown themselves valuable in a 2-year test. The Michigan Amber and Dawson Golden Chaff are beardless, while the others named are bearded varieties. In addition to these wheats the following varieties may be safely recommended: Grains o' Gold, Mealy, Winter King, Poole, Harvest King, Farmers Trust, Red Wave, Reliable, and Fultz.

Ohio.—In a 16-year varietal test at the Ohio Agricultural Experiment Station, Dawson Golden Chaff has led in yield. This wheat.

FIG. 6.—Heads of bearded winter wheat, representative of group 5, as follows: 1, Turkey; 2, Bearded Purple Straw; 3, Fulcaster.

it must be remembered, however, is not a red but an amber or white wheat. The red wheats in the order of average yield are the Nigger, Gipsy, Perfection, Poole, Valley, Mealy, and Harvest King. Each of these varieties has averaged between 30 and 31 bushels per acre for the 16 years tested. The first five of these have been proved by tests to be of value in four widely separated counties and can doubtless be recommended for general sowing in the State. The Gipsy, Nigger, and Valley are bearded varieties, while the others named are beardless.

Michigan.—Comparative yields secured and baking tests made with a number of wheats for three years at the Michigan Agricultural Experiment Station indicate that Shepherd Perfection is the best red wheat for general growing in that locality. It was exceeded in yield, however, by the white wheats, Early Windsor and Dawson Golden Chaff. The Budapest, a red wheat, gave good yields, but slightly under the others. The American Banner, a white wheat, yielded well for two years and was winter resistant. Of these varieties, Shepherd Perfection and Budapest are bearded, while the others are beardless.

The North Atlantic States.

Virginia.—Varieties adapted to the western part of Virginia are the Fulcaster, Blue Ridge, and Mediterranean (bearded varieties), and the Fultz, Harvest King, and Perfection (beardless varieties). The bearded varieties have yielded better than the beardless ones. For the northern and eastern parts of the State, tests at Arlington indicate that the following varieties are all well adapted: Purple Straw, Poole, and China (beardless varieties), and Dietz, Bearded Purple Straw, Virginia, and Mammoth Red (bearded varieties) of the red wheats and Dawson Golden Chaff of the white wheats. Many other varieties yielded about as well, and it is impossible to say that any one is best for general sowing.

West Virginia.—Extensive varietal tests have not been made in West Virginia. The Gipsy, Poole, Dawson Golden Chaff, Nigger, Velvet Chaff, and Rudy are some of those doing well in tests now being conducted at the State experiment station.

Maryland.—The following varieties of wheat are adapted to Maryland: China and Currell Prolific (beardless red wheats), Bearded Purple Straw, Dietz Longberry, Turkish Amber, and Mammoth Red (bearded red wheats), and Dawson Golden Chaff (a beardless white wheat).

Delaware.—In Delaware the following varieties of wheat have yielded well and seem adapted to the conditions: Rudy, Gipsy, Red Wonder (bearded varieties), and Leap Prolific, Currell Prolific, and Perfection (beardless varieties).

New Jersey.—Fulcaster (bearded) and Fultz (beardless), both red wheats, and Dawson Golden Chaff (a beardless white wheat) can be recommended for growing in New Jersey.

Pennsylvania.—Varieties of red winter wheat adapted to Pennsylvania are the Harvest King (good for rich land), Fulcaster (not so good for low lands), China, Turkish Amber, Currell Prolific, Ontario Wonder, and Reliable. These, however, have been out-yielded by Dawson Golden Chaff, a white wheat. The Jones Longberry No. 1 and the Gold Coin (or Fortyfold), white wheats, have also done very well. The Fulcaster, Turkish Amber, Jones Longberry No. 1, and Reliable are bearded, while the others named are beardless varieties.

New York.—New York should probably be considered in the white winter-wheat district, as white wheats are most commonly grown. Several of the red wheats, however, have yielded well in recent tests. The best of these are the Prosperity and the Fultz, beardless varieties, and Rural New Yorker No. 57, a bearded variety. Adapted varieties of white wheat are given below.

SOFT WHITE WINTER WHEAT.

The principal district growing soft white winter wheat comprises New York and Pennsylvania and portions of the States lying immediately south and east of them. White wheat is not the only kind grown in this district, red wheat being also largely grown. On the other hand, more or less white wheat is grown throughout the soft red winter wheat district.

In New York and under similar conditions, speaking generally, white wheats yield more grain per acre, possess stronger straw, weigh a little less to the measured bushel, have slightly softer grains, and furnish a better pastry flour but a somewhat weaker bread flour than the red varieties.

DEMAND FOR SOFT WHITE WHEAT.

There is a considerable demand for soft white wheat in New York and adjoining States by manufacturers of whole-wheat foods and pastry flours. When the local supply is inadequate, this class of wheat is sometimes brought from the Pacific coast. There is also a large local demand for wheat as poultry feed in these States and in New England, and the variety giving the largest yields of grain will probably be found most profitable where such demand exists, irrespective of the milling value of the wheat. Where white wheat yields best, therefore, and there is a good market for it, the growing of such wheat is recommended.

ADAPTED VARIETIES OF SOFT WHITE WINTER WHEAT.

The white wheats which have succeeded well in the North-Central and North Atlantic States are as follows:

Indiana.—Dawson Golden Chaff.

Michigan.—Early Windsor, Dawson Golden Chaff, American Banner.

Ohio, Virginia, West Virginia, Maryland, and New Jersey.—Dawson Golden Chaff.

Pennsylvania.—Dawson Golden Chaff, Gold Coin (or Fortyfold).

New York.—Dawson Golden Chaff, Gold Coin (or Fortyfold), New Soule. Extra Early Windsor, Jones Longberry No. 1, Early Genesee Giant.

Dawson Golden Chaff is probably the leading variety of soft white winter wheat. It has been one of the highest yielding varieties among all the wheats tested in the States just mentioned. This variety stands up well in the field and is above the average in winter resistance. The grains are somewhat harder than those of most other white wheats. In several milling and baking tests that have been made it has given a good yield of flour, rather low in total protein content, but containing gluten of excellent quality.

WHEAT IN THE NEW ENGLAND STATES.

Very little wheat is raised in the New England States. In 1913 Maine and Vermont produced 76,000 and 24,000 bushels, respectively. No other State of this group is credited with wheat production. Spring wheat is the cnly kind reported as being grown in the two States just mentioned. The fife and the bluestem groups, spring wheats, are adapted to these States.

Tests made by the Connecticut Agricultural Experiment Station at New Haven during the seasons of 1911–12 and 1912–13 with seed of 14 varieties of winter wheat furnished by the United States Department of Agriculture indicate that all of the varieties tried can be successfully grown in that locality. Although all these varieties were grown under adverse soil conditions, the average yield for the two years is above 18 bushels in every case. The six leading varieties in the order of yield are Dawson Golden Chaff, Fultzo-Mediterranean, Dietz, Bearded Winter Fife, Fultz, and Maryland Flint. Dawson Golden Chaff yielded at the rate of 29 bushels per acre, while the other five varieties each yielded approximately 23 bushels per acre. It is probable that Dawson Golden Chaff is one of the best yielding winter varieties for the New England States.

There is a large local demand in New England for wheat as a poultry or stock feed. It should not be difficult for several farmers in almost every neighborhood to sell at a good price to their neighbors all the wheat which they can raise. The growing of wheat on land adapted to its culture is therefore likely to prove profitable in New England, and the farmers of this section would do well to consider carefully the addition of wheat to the crops which they grow. Winter wheat will doubtless give better average yields than spring wheat if proper cultural methods are employed and suitable varieties are used.

IMPROVEMENT OF VARIETIES.

Many farmers are doubtless growing inferior varieties of wheat. The first concern of every grower should be to determine by test or otherwise the variety best suited to his conditions. Having determined this point, he should then begin and faithfully continue systematic efforts to improve this variety for the conditions of his farm. The method of improvement to be adopted should depend upon the importance of the wheat crop on the farm in question and the time and facilities at the disposal of the farmer. Every farmer should at least use clean, plump, heavy seed and should also be on the lookout for striking variations, or sports, which probably occur rarely in a field of wheat, but which may occur at any time. Several of our most valuable varieties have originated from single plants, slightly different from others about them, which have been found, preserved, and propagated by careful, observant farmers.

Another method of wheat improvement is by the selection of good heads or good plants from the general field and growing the seed from each individual head or plant in separate rows. At harvest time the best rows are thrashed and preserved separately and each lot thus obtained is sown again in separate rows of suitable length. This is continued year after year until a few superior strains are obtained, which may be rapidly increased in larger plats.

The method of most general application, however, is one which may be called "mass selection." No great amount of time or extra labor is required by this method to secure satisfactory results. In applying it, a field of wheat is examined at harvest time and enough good heads are selected to make a bushel or more of seed. This is thrashed separately and sown in the ordinary way in a field or plat of good fertility. It may be sown in a marked portion of a general wheat field. At harvest time the best heads are picked from the plat sown with the special seed, just as they were picked from the general field the year before, and these heads are handled and sown as were those selected the previous year. The remainder of the plat is cut and thrashed separately, and the grain thus obtained is used as seed for the general crop. This method of selection should be continued year after year as a means of providing good seed for the general wheat crop on the farm.

THE GROUPING OF ADAPTED VARIETIES OF WHEAT.

The wheats recommended herein are grouped below in accordance with some of the most obvious and most easily determined characters. The terms used in the description are red, white, and amber—to denote the color of the wheat kernels; bearded and beardless—to denote the presence or absence of beards on the heads; white or yellow and red or brown—to denote the color of the chaff (no attempt being made to distinguish white from yellow or red from brown); and velvet and smooth—to denote the presence or absence of hairs or velvet covering on the chaff. The following classification is made according to the descriptions most commonly given of the different varieties:

(1) Red kernels, beardless, smooth white or yellow chaff.
Hard spring.—Fife (Minnesota No. 163).
Soft or semihard winter.—Alabama Bluestem, Alabama Red, Extra Early Oakley, Fultz, Fultzo-Mediterranean, Georgia Bluestem, Georgia Red, Harvest Queen,[1] Hickman, Jersey Fultz, Leap Prolific, Ontario Wonder, Prosperity, Purple Straw, Red May,[2] Zimmerman.

(2) Red kernels, beardless, smooth red or brown chaff.
Soft or semihard winter.—Beechwood Hybrid, China, Currell Prolific, Early Red Clawson, Early Ripe, German Emperor,[3] Golden Chaff. Harvest King, Michigan Amber, Michigan Wonder, Perfection, Poole Red Russian, Red Wave, Rochester Red, Wheedling.

(3) Red kernels, beardless, velvet white or yellow chaff.
Hard spring.—Bolton Bluestem, Haynes Bluestem, Minnesota No. 169 (selection from Haynes Bluestem).
Soft or semihard winter.—Mealy, Jones Winter Fife.

(4) Red kernels, beardless, velvet red or brown chaff.
Soft or semihard winter.—St. Louis Grand Prize.

(5) Red kernels, beared, smooth white or yellow chaff.
Soft or semihard winter.—Bearded Purple Straw, Budapest, Dietz (or Dietz Longberry), Egyptian Amber, Farmers Friend, Fulcaster, Grains o' Gold, Gipsy, Ironclad, Kansas Mortgage Lifter, Lebanon, Mammoth Red, Nigger, Red Wonder,[4] Reliable, Rudy, Turkish Amber, Valley, Winter King.
Hard winter.—Beloglina, Crimean, Kharkof, Malakof, Turkey.
Hard spring.—Early Java, Johnson, Preston.

(6) Red kernels, bearded, smooth red or brown chaff.
Soft or semihard winter.—Blue Ridge, Farmers Trust, Lancaster, Mediterranean, Missouri Bluestem, Shepherd Perfection, Sibley New Golden.

(7) Red kernels, bearded, velvet white or yellow chaff.
Soft or semihard winter.—Rural New Yorker No. 57, Virginia.

(8) Red kernels, bearded, velvet red or brown chaff.
Soft or semihard winter.—Velvet Chaff.

(9) White or amber kernels, beardless, smooth white or yellow chaff.
Soft winter.—Early Ontario, Kentucky Bluestem.

(10) White or amber kernels, beardless, smooth red or brown chaff.
Soft winter.—American Banner, Early Windsor, Dawson Golden Chaff, Gold Coin (or Fortyfold), New Soule.

(11) White or amber kernels, bearded, smooth white or yellow chaff.
Soft winter.—Seneca Chief.

(12) White or amber kernels, bearded, smooth red or brown chaff.
Soft winter.—Early Genesee Giant, Jones Longberry No. 1.

(13) White or amber kernels, bearded, velvet white or yellow chaff.
Soft winter.—Bearded Winter Fife.

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[1] Another variety having white kernels is grown under this name.
[2] A red or brown chaffed strain is also grown.
[3] A white-chaffed strain is also grown.
[4] A red-chaffed strain is also grown.

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SCHOOL LESSONS ON CORN.

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INTRODUCTION.

For a considerable number of years more attention has been given by farmers to the production and improvement of corn than to any other grain or general farm crop, yet for no 10-year period has the average corn yield of the United States exceeded 28 bushels per acre. No State has averaged for any year over 54 bushels per acre, yet in practically every section of the United States yields of more than 100 bushels per acre have been produced. With the rapid spread of the work of boys' clubs the need of the study of corn in the schools has come to be better appreciated. The purpose of this bulletin is to furnish lessons for developing the real educational value of this study.

LESSON I.

Subject.—Kinds of corn.

Topics for study.—Points of difference between flint, pop, sweet, and dent corn. What is each kind mostly used for? How many kinds are grown in your school district? Which has proved most profitable? Which produces the larger annual crop, corn or wheat?

Exercises.—Have six or more pupils bring 10 ears of the best corn they can find at home. It would be better if all could bring the same kind of corn. Before the pupils attempt to select the most desirable ears for seed have them read the references. Then have the pupils select 20 or 30 of the best-looking ears for use in the lesson on judging corn.

References.—Farmers' Bulletins 229, pp. 8, 9; 253, pp. 6, 7; 415, pp. 6, 7; 537, pp. 18, 19; 553; 554.

Note.—Furnishes elementary lessons on corn and is of interest to rural-school teachers in all parts of the United States.

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LESSON II.

Subject.—Judging corn.

Topics for study.—Object of corn judging. Value of "corn score card." Preparation of local corn exhibit. Learn how to judge of the maturity, vitality, and distinctness of type of corn.

Exercises.—Provide each pupil with 10 ears of corn and let him practice scoring, using the score card given. Each pupil should score a half dozen or more 10-ear samples before this exercise is passed by. Number all of the ears from 1 to 20 or 1 to 30, as the case may be, by tying to each a small numbered tag or sticking a numbered peg into the butt of each cob. Have each pupil provide himself with a score card ruled as shown below, providing one column for each ear of corn. The figures in the score card just to the left of the first perpendicular line show the number of "points" that should be given for a perfect ear, e. g., if the pupil thinks ear No. 4 is nearly perfect in shape he would probably mark 9 in line 2, column 4, as shown in the table. Each pupil should examine carefully each ear of corn and put down on his score card, in the column of the same number as the ear of corn, his estimate of the qualities named on each line at the left, except line 4—vitality—which should not be filled in until after the seed is tested by the method explained on page 3.

Then compute the germinating value of the different samples on the basis of 20 for a perfect ear, as shown in the score card, and give each ear its proper rating in line 4 of the score card. Now add up the different columns of figures in the score card, and by means of the totals select the best five ears.

Score card for corn.

Points.		1	2	3	4	5	6	7	8	9	10
1. Trueness to type	10										
2. Shape of ear	10										
3. Purity of color in grain and cob	5										
4. Vitality, maturity, germinating power	20										
5. Tips of ears	5										
6. Butts of ears	5										
7. Uniformity of kernels	5										
8. Shape of kernels	5										
9. Length of ear	5										
10. Circumference of ear	5										
11. Furrows between rows	5										
12. Space between kernels at cob	10										
13. Proportion of corn to cob	10										
Total	100										

In order to understand the meaning of all the points listed in this score card it is well to write to the State agricultural college or to the State corn breeders' association, if there is one, for an explanation of the official score card used in your State; or it may be possible to get some one from the agricultural college or other agricultural school to come to your school or county teachers' meeting and explain the score card fully.

References.—Corn score card published by the State agricultural college. State corn breeders' association, if there is one.

LESSON III.

Subject.—Seed corn.

Topics for study.—What constitutes good seed corn? Where to obtain the best possible seed corn. How to gather seed corn. Treatment of seed immediately after gathering. Destroying weevils or grain moths. Winter storage of seed corn. Method of shelling.

Exercises.—Compare the methods outlined in Farmers' Bulletin 415 with those in practice in the vicinity of the school. What advantages for the various methods are apparent? See that the pupils actually perform as many as time will permit of the operations for gathering and storing seed corn as are outlined in this particular bulletin.

References.—Farmers' Bulletins 193, pp. 20–26; 225, pp. 9, 10; 229; 244, pp. 5, 7; 253; 415.

LESSON IV.

Subject.—Testing seed corn.

Topics for study.—Importance of testing the vitality of corn. How to make germinating boxes. Care of the germinating box. Ears to be saved for seed. Grading of the seed ears.

Exercises.—Have the pupils study and make the germinating test as outlined in Farmers' Bulletin 253.

References.—Farmers' Bulletins 253, pp. 8–10; 415, p. 12; 537, p. 9.

LESSON V.

Subject.—Place of corn in crop rotation.

Topics for study.—(1) Reasons for rotation: (*a*) Different crops make different requirements of the soil; (*b*) root systems differ; (*c*) crops should be selected to suit varying seasonal conditions; (*d*) the culture of one crop prepares for a succeeding crop of a particular kind; (*e*) distribution of labor. (2) Corn in systems of rotation.

Exercises.—Draw plans of the home farm, showing fields, and write in each field the crops in the order in which they were grown during the last five years. Write to the State agricultural college for (*a*) a system of crop rotation in grain farming and for (*b*) a system of rotation in live-stock farming.

References.—Farmers' Bulletins 242; 310, pp. 12, 13, 21, 22; 325; 422; 537.

LESSON VI.

Subject.—Preparation of the seed bed.

Topics for study.—Soil conditions necessary. Time of plowing. Purpose of plowing. Depth of plowing. Characteristics of a good seed bed. When should cover crops be turned under for corn?

Exercises.—Show the effect of plowing under cloddy soil, or a large cover crop, on the rise of capillary water. Also the effect of disking a cover crop or heavy coating of manure into the surface soil before turning under. Use four lamp chimneys, numbered 1, 2, 3, and 4. Fill all to a depth of 5 inches with a sandy soil. Finish filling No. 1, using good loam soil. On top of the sand in No. 2 put 1 inch of wheat or oat chaff well packed down. In No. 3 put 2 inches of fine clods. Finish filling Nos. 2 and 3 with loam soil. Complete the filling of No. 4 by using a mixture of loam and the same amount of chaff used in No. 2. Set all chimneys in about 1 inch of water. Observe and explain results.

References.—Farmers' Bulletins 414, pp. 6, 7, 13, 17, 18; 537, pp. 12, 13, 14.

LESSON VII.

Subject.—Fertilizers and how to apply them.

Topics for study.—What are the indispensable requirements for a good corn yield? What is one of the surest fertilizers for producing a large corn crop? Why? How many tons of well-decomposed and moist barnyard manure may you safely apply? Manure containing stalks or undecomposed straw may reduce the corn yield. Explain. When should the manure be applied? What element of plant food is needed most by the soils for profitable corn production in your district? What necessary elements of plant food do commercial fertilizers supply? When are such fertilizers likely to be profitable and how should they be applied? Show the relation between profitable corn production and the use of lime, ground phosphate rock, and legumes on different kinds of soils. Name the steps necessary in building up the soil permanently on a run-down farm in your district.

References.—Farmers' Bulletins 44; 192, p. 5; 326, p. 10; 398; 414, pp. 12, 13; 537, pp. 10, 11.

LESSON VIII.

Subject.—When and how to plant field corn.

Topics for study.—At what time do the best farmers in your school district plant their corn fields? What is the old Indian rule? Why do the farmers not plant earlier? Why do they wish to plant corn as early as it is safe? Do most of them plant in continuous drills or in hills? How far are the rows spaced apart? How far apart are the hills in each row? What is a "check rower?" How many kernels are planted in a hill? What is the secret of a prize-winning corn crop?

Exercises.—How many kernels are needed to plant an acre of ground? How many ears does that require? How many farmers in your district take their seed ears from the corncrib in the spring? Is there any certain way to find whether they will grow before planting them in the field? (See p. 3.) How many kernels in a quart of good shelled seed corn of the kinds commonly grown in the locality? How many quarts are needed to plant an acre? How many bushels for 40 acres? How many bushels of shelled corn do the best farmers in your district raise on an acre? How does this compare with the best yields made by the boys' corn clubs in your State?

References.—Farmers' Bulletins 414, pp. 19–24; 537, pp. 14, 15.

LESSON IX.

Subject.—The cultivation of corn.

Topics for study.—Purposes of cultivating corn. Importance of first cultivation. Shallow cultivation. Meaning of a soil mulch. Purpose of a mulch. Proper depth. Frequency of renewal.

Exercises.—The effect of a soil mulch may be shown by filling two cans or flower pots with soil and planting corn. When the plants are 3 inches high cover the soil in one pot with a layer of coarse sand or granular dry soil to a depth of 1 inch. Place in the window and observe which plants first show the need of water.

References.—Directions for the proper cultivation of corn are given in Farmers' Bulletin 229 for the "Corn Belt States," and in Farmers' Bulletin 81 for States farther south. Farmers' Bulletin 537, pages 16 and 17, gives general directions for cultivating corn with a view to producing a maximum yield. Nearly every State has one or more bulletins on this subject. These should always be procured from the State agricultural college and studied in the class.

LESSON X.

Subject.—Corn diseases and pests.

Topics for study.—The corn root-louse. The chinch bug. The corn ear-worm. Weeds. Corn smut.

Exercises.—Find out from the farmers in the district whether corn has any serious pests, such as birds, insects, or diseases. If possible, have the pupils collect and preserve for the school exhibit local corn diseases and insect pests.

References.—Farmers' Bulletins 54, pp. 18–23, 29, 30; 78, p. 27; 259, p. 20; 537, pp. 15, 16.

LESSON XI.

Subject.—The food value of corn.

Topics for study.—Is most of the corn in your State fed or shipped? Which is cheaper, to ship the corn or to ship an animal that was fed on it? About how many bushels of corn are required to feed a 250-pound hog?. How much would it cost to ship the corn to the nearest large stock market—Chicago, Omaha, Kansas City, or Buffalo? To ship the hog? In addition to its value as feed for stock, corn is largely used as human food. In what ways is it used as a food? What products are manufactured from corn? What ones have you seen? What samples of them do you have in your school museum?

Exercises.—When you sell $10 worth of corn from the farm you sell $3.78 worth of fertilizer; when you sell $10 worth of cattle you sell $1.18 worth of fertilizer. Which would be more profitable—to sell corn or to feed it to cattle and sell the cattle? Which method of farming would keep the land in good condition longer? Have the pupils study and recite on Farmers' Bulletins 56, 65, 97, and 122. All these deal with some phase of feeding corn to farm animals. The girls in the class will be interested in studying the value of corn as a food for human beings, as discussed particularly in Farmers' Bulletin 565.

References.—Farmers' Bulletins 56, pp. 4, 7–9; 65, p. 6; 97, pp. 9–12; 122, pp. 26, 27; 249; 281, pp. 18–22; 298; 553; 554; 559; 565.

LESSON XII.

Subject.—The botany of corn.

Topics for study.—Corn flowers: Does the corn have flowers like wheat? Where are the stamens in corn? Where are the pistils? What is the yellow powder that one sees on the ground just as the silks begin to show? Why so much of it? Why is dry weather particularly bad for corn at this time? When a cornstalk grows in a place by itself what kind of an ear does it have? Why is this? Open an ear of corn that has just "silked out." Follow the threads of silk. Where are they attached to the kernels?

(The corn stamens are normally borne in the tassel. The silks and the kernels to which they are attached are the pistils. The pollen must fall or be blown from the tassel to the silk in order to fertilize the kernel and make it develop. There must be a great abundance of pollen, because so much is lost. Each silk extends to one kernel only.)

The corn leaves and stalks: How are the leaves arranged on the stalks? What is the position of the ears with respect to the leaves? Notice that the margin of the leaf is longer than the middle of the leaf. This makes the leaf wavy. Would this help to prevent the wind from tearing the leaves? Does the wind damage corn leaves much in your country? What do the corn leaves do in very dry weather? Is this an advantage to the corn plant? How? Cut across a cornstalk. Notice the threads that run through it. Where are they thickest—in the middle or near the outside of the stalk? These threads are woody bundles called fibro-vascular bundles. Split a stalk and see if they go the whole length of it. Do they extend into the leaf? Cut out about 3 inches of a stalk between joints. Put one end of this in water and blow through it. Through what part of the stalk does the air go? The chief function of the fibro-vascular bundles is to conduct the sap up and the prepared food down in the plant. They extend into the leaves and become the veins, and thus help to make up the leaf framework.

The joints of the cornstalk are called "nodes," and the spaces between them are called "internodes." If a stalk of corn is broken down, at what point does it begin to straighten up again? Is the node, then, of the same length all around? Which side of the internodes is flattened or channeled? Is it the same side all the way up? What other crop plants have nodes and internodes like corn? Is corn a grass plant? Is wheat, flax, clover?

Corn ears: On which side of the internode is the ear always found? Is a leaf sheath always found on the other side of the ear? Suppose the ear were borne on the end of a long branch, with leaves arranged just as they are on the stalk. Now, if you could "telescope" this branch from tip to base, so that it would be only an inch long, would the leaves, then, have the place of husks around the ear? Are the husks corn leaves? What is the short branch that bears the ear called? How does it come to be so short? Could it hold a large ear up off the ground if it were very long? Is it better to have the shank hold the ear upright or allow the tip to hang down a little? Why? What is the advantage in having the tassel at the top of the stalk? Which would be the better kind of corn to cultivate—the sort we have now, or one with long stalks and branches and with both stamens and pistils at the ends? Do we sometimes still find a few kernels in the tassels or parts of the tassel attached to the ear? (Have such specimens collected at husking time and brought to the school.) Are they the best kind of corn to plant? (Try it and see.)

Corn roots: Dig down around a hill of corn and see how near the surface the roots grow. How far do they extend from the stalk? How deep could the cultivator go without hurting these roots? (Fig. 1.) About the time that the corn tassels come out the "brace roots" appear. Find some of these roots. What is their use?

Exercises.—Bring a sufficient number of cornstalks into the schoolroom, or, better still, go with the class to a field of standing corn. Make notes of your observations in answer to questions on Topics for Study.

References.—Farmers' Bulletin 229. Textbooks on Elementary Agriculture.

OBSERVING CORN DAY.[1]

To make this day a success, not only the children, but the parents, must be enlisted. The social element in it is very important. Every parent must be so interested that he will feel he must be present. Plan for an entire day given to the special occasion. If there is one in the vicinity who can give anything valuable about agriculture, secure him as a speaker. If this is done, have two programs,

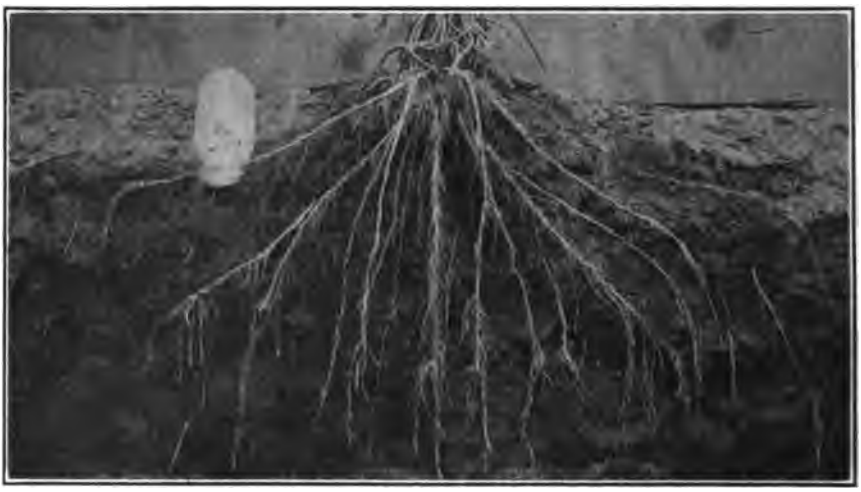

FIG. 1.—Distribution of corn roots, showing how late deep cultivation affects the roots.

one in the forenoon for the speaker and one in the afternoon, when the children shall take the prominent place.

For the children's program plan to show the results of the work done in the study of corn. Let it include the best compositions written on the more interesting phases of the work. The History of Corn, The Indian Corn Dance, The Importance of Corn in America, The Development of Breakfast Foods, The Possibilities in a Corn Stalk, How Six Ears Went to Market, The Story of a Stalk of Corn, Number of Days of Work Needed for One Man and a Team to Raise and Harvest an Acre of Corn are suggested as additional subjects.

[1] Adapted from Corn Day Annual, Schools of Illinois, 1913.

The history and work of the farmers' institute should be reported by one of the older pupils. Another should give an account of what the agricultural college is doing for the State.

If sufficient interest has been aroused, a corn-judging contest might be held. For judging the corn exhibits prepared by the pupils secure some man who has studied corn judging. Be sure to make this a feature of the day, making the announcing of the results a part of the program.

Music should not be omitted from the program. Some patriotic music should be included, as should the State song.

The following program may be suggestive:

Quotation on Corn.
The Gift of Mondamin.
Hiawatha Blessing the Cornfields.
The Feast of the Mondamin.
The Corn Song.
The Place Corn Has in Our History.
From a Tiny Grain to a Mighty Ear.
The Huskers.
The Husking Bee.
Maize, Our National Emblem.
What I Think is a Good Ear of Corn.
Columbia's Emblem.
Why I Think Corn and Boys are Similar.
The Uses of Corn.
"When the Frost is On the Pumpkin."
Why Corn Should Be Our Emblem.

Plan to have dinner at the school, and use every device possible to make it a corn dinner. There are many ways in which corn can be prepared which will add to the effectiveness of the plan. If the number of people is not too large, a splendid lesson in art would be the making of place cards and decorating them with some corn design. If these are not made, souvenirs of the day should be made by the pupils, carrying out the corn idea. This is one real way to teach decorative art.

For a language lesson prepare written invitations to the patrons of the school. Perhaps the form side of notes of invitation will be more vividly taught then. Be sure to include the local editor in the list of invitations. Have a report of Corn Day written by some of the pupils for the local papers.

The decoration of the schoolroom should not be neglected. Some suggestions as to using blackboard drawings, booklets, corn products, and other work of the pupils have been given. Use some fine specimens of corn in completing the decorations. Grains of yellow, white, and red corn are full of possibilities, as are the stalks. The rooms

FIG. 2.—A poorly selected corn exhibit. The second ear has a pronounced "twist" in the row of kernels, and the ninth ear has a very poor tip.

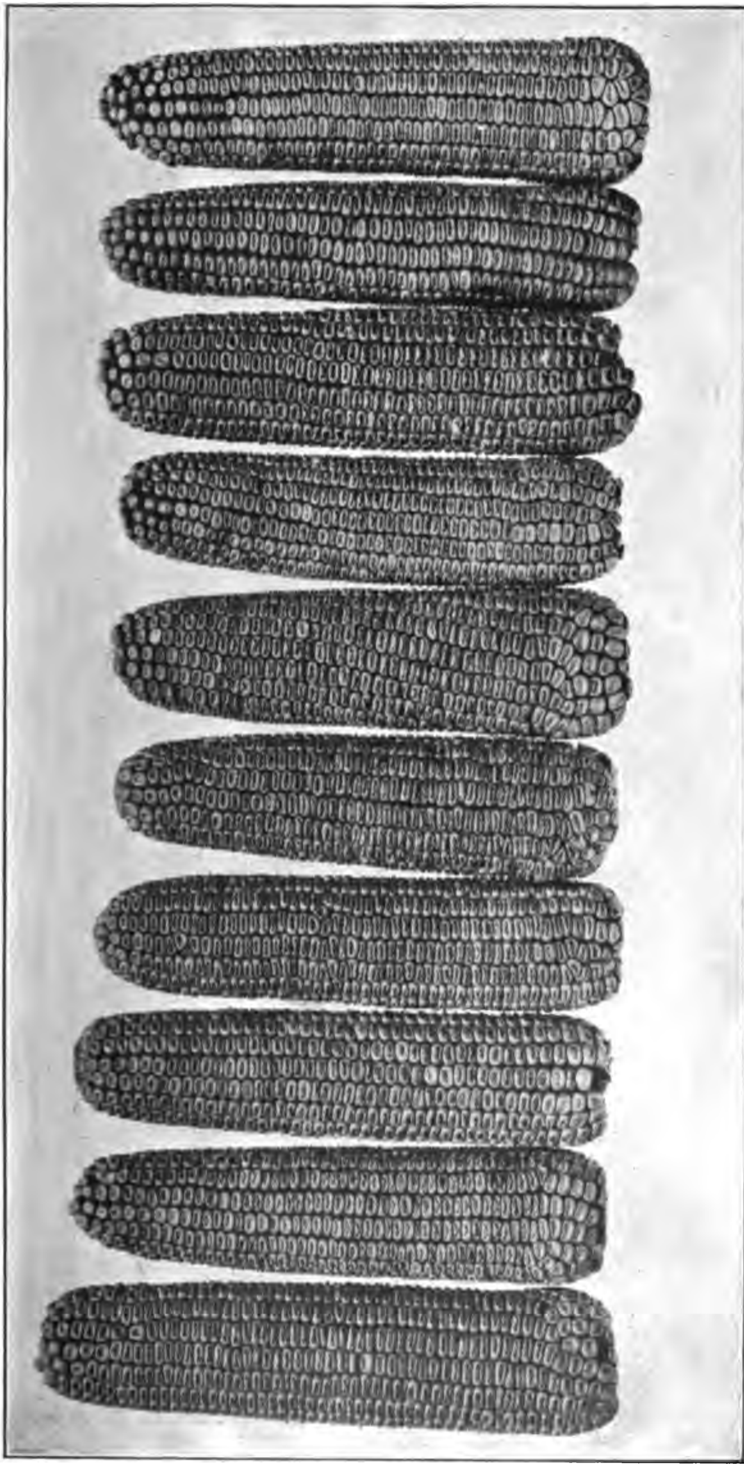

FIG. 3.—A well-selected exhibit. The substitution of two good ears for the second and ninth of figure 2 gives a satisfactory degree of uniformity to the entire set.

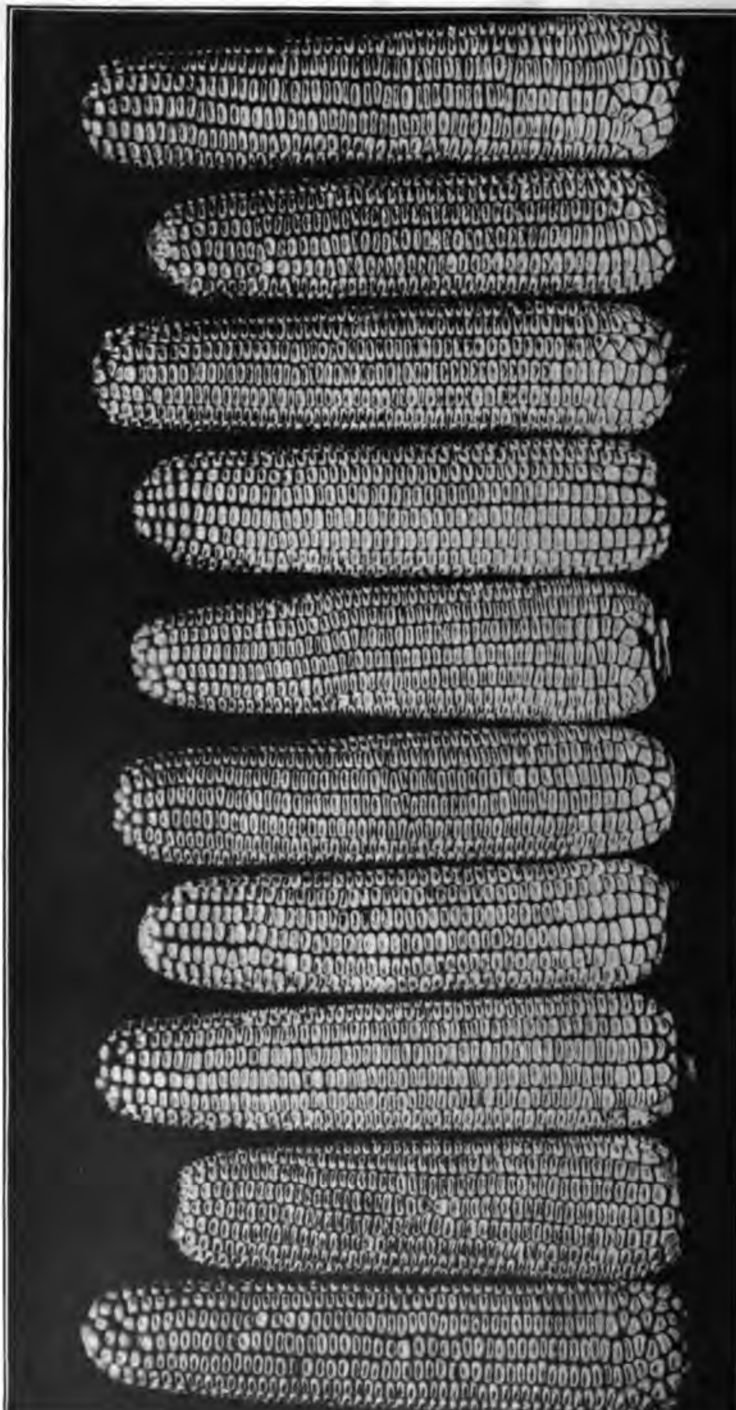

FIG. 4.—A poorly arranged exhibit; decidedly lacking in uniformity of appearance.

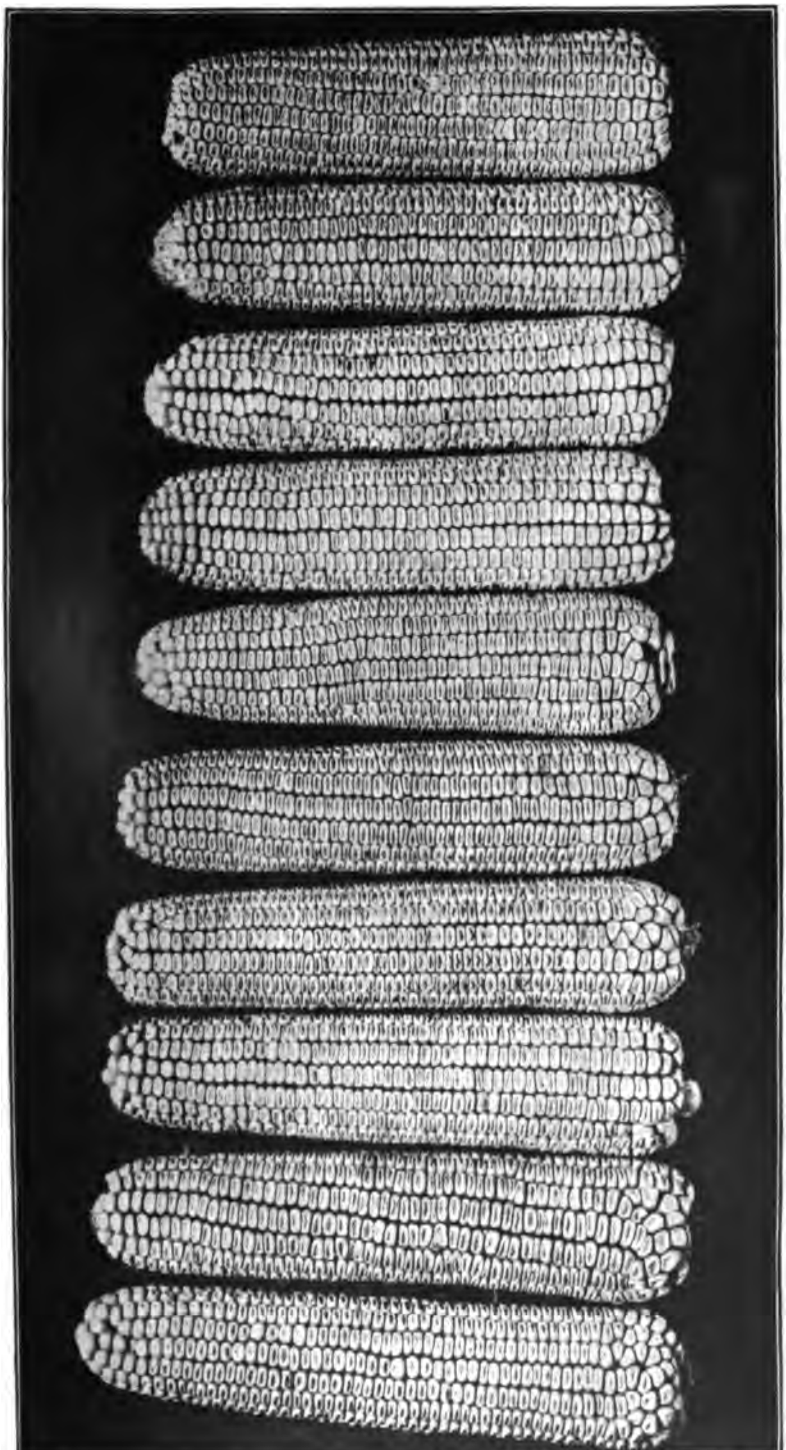

FIG. 5.—The same exhibit properly arranged; ears nicely graduated as to length.

should be decorated so as to give joy and impress the thought that the man who raises a good crop of corn is engaged in an exalted work.

The following letter might be sent to all patrons of the school:

DEAR FRIEND AND PATRON OF THE ——— SCHOOL:

The teachers and pupils of ——— School, in response to the suggestion of the State superintendent, have decided to have, on ———, a "Corn and Other Products Day," and we cordially invite your cooperation and attendance. Bring good samples of corn, fruit, potatoes, tomatoes, poultry, and other home or farm products that you care to exhibit, and help us to make it a day of educational value. A special program, participated in by the pupils and others, will be a feature of the day.

Please bear in mind that this is your school and that your cooperation and presence will be both a help and an inspiration.

Sincerely yours,

——— ———, *Teacher.*

SELECTING THE EXHIBIT FOR CORN DAY.

The exhibit from one person usually consists of 5 or 10 ears of corn. Sometimes a 10-ear exhibit to represent the entire local school is made up by selecting that number of ears from the best ones brought in by all the members of the school.

One very important thing to observe in choosing and arranging all such exhibits is the principle of *uniformity.* This is sometimes indicated in score cards by the phrase "uniformity of exhibit." In the score-card form shown on page 2 it is covered by "trueness to type" and "uniformity of kernels." These phrases all mean that in order to get a high rating all the ears in the set must *look alike* as nearly as possible. A corn judge often discards a set of 5 or 10 ears from any further consideration simply because the exhibitor included among them one ear that was an inch longer than the rest, or of a different shade in color, or that had a different number of rows of kernels, or kernels of noticeably different shape or size than those on the rest of the ears. Sometimes the size of cob in one ear differs from all the others, or one ear is crooked or has "twisted" rows of kernels, while all the rest are straight.

Any of these defects spoil the *uniformity* of the set and cause the set to be marked down severely. It is better to select 10 ears that are not the very best, but are *alike,* than to include one ear that is either much better or much worse than all the rest in the set. Pick out the best 40 or 50 ears you can find, and then from these, by careful measurement and comparison, select for your exhibit the 5 or 10 that are nearest alike.

The unfavorable impression made by a poorly selected or poorly arranged exhibit of 10 ears is clearly illustrated in figures 2 and 4 (pp. 10, 12). Without discarding any ears from the best 10 selected they can always be *arranged* in one *best* order, from left to right, so as to present whatever excellence they have in the most favorable view.

(See figs. 3 and 5, pp. 11, 13.) The corn judge may change this order before giving his final verdict, but in any case he will be disposed to give the exhibitor credit for knowing the advantages of a good arrangement. Furthermore, a good arrangement of the ears in an exhibit saves time for the judge, and that, too, is in the exhibitor's favor if the judging must be done rapidly.

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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

618

Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.
October 8, 1914.

LEAF-SPOT, A DISEASE OF THE SUGAR BEET.

By C. O. Townsend,
Pathologist in Charge of Sugar-Beet Investigations.

INTRODUCTION.

Leaf-spot is one of the best known and most widely distributed diseases of the sugar beet (fig. 1). It is caused by a well-defined fungus (mold) known by the name of *Cercospora beticola.* These fungi (molds) are low forms of plants that depend for their existence upon other forms of plant or animal life. In this particular case the leaf-spot fungus penetrates the tissues of the leaf and leaf stem of the beet and feeds upon the material that the beet plant has prepared for its own growth and development. It is plain, therefore, that any considerable number of these fungous plants feeding upon a single beet plant must necessarily retard its growth. Furthermore, since the sugar of the beet is all made in the leaves of the beet plant, any appreciable injury to the leaf surface must reduce the sugar-making ability of the infested plants. Consequently, leaf-spot tends to reduce both the tonnage and the sugar content of the beets affected.

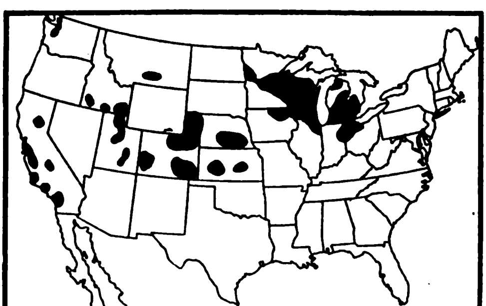

Fig. 1.—Sketch map of the United States, the black spots showing areas of occurrence of sugar-beet leaf-spot.

The amount of injury done by the fungus in any particular field of beets will depend upon the number of fungous plants that attack the beet and upon the time in the life of the crop when the attack begins. After a beet plant has become infested with leaf-spot there is no known method by which the fungus can be destroyed without destroying or killing the beet leaves. It is evident, therefore, that

Note.—A description of leaf-spot, a widespread disease of the sugar beet, its reproduction, distribution, injurious effects, and methods of control are presented in this bulletin.

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control methods for leaf-spot must be preventive rather than curative. There are simple and effective means along the line of good agricultural practice by which the attacks of this fungus may be prevented, and it is the object of this paper to point out these preventive methods.

APPEARANCE OF LEAF-SPOT.

In considering any plant disease it is important to be able to recognize it in the field; otherwise, the success or failure of efforts toward prevention can not be known. The following brief description of leaf-spot as it appears in the field is therefore of importance in this connection.

FIG. 2.—A young sugar-beet plant, showing the early stages of leaf-spot. (About one-third natural size.)

The first distinct appearance of leaf-spot is a tiny point which is nearly white, indicating that the destruction of the tissue of the leaf has begun. These tiny spots, or points, so small that they are seen with difficulty by the unaided eye (fig. 2), increase more or less rapidly in size and assume a brownish color. These small brown and at first nearly round spots, which are scattered irregularly over the surfaces of the infested leaves and leaf stems and which may vary in number from less than a dozen to several hundred on the same leaf, are easily seen and to the casual observer are the first indication of the presence of the disease (fig. 3). The spots appear first on the outer and therefore older leaves of the beet, and if conditions are favorable for their development they soon cover these leaves, and the adjacent leaves are similarly attacked. In this manner several of the outer or older whorls of leaves are infested, and as the adjacent leaves toward the center of the crown become older they are likewise attacked. Very rarely do the youngest center leaves show the characteristic brown spots which indicate the presence of leaf-spot, even when the disease is severe enough to kill the outer leaves. Consequently, the beet plants are seldom killed by this disease, although it frequently interferes seriously with their growth and development and with the quality of the roots.

FIG. 3.—A diseased leaf of a sugar-beet plant, showing the relative size, shape, and distribution of spots produced by the leaf-spot fungus. (About one-third natural size.)

The spots on the infested leaves continue to increase in size more or less rapidly, depending upon the conditions which influence the growth of the fungus, but they show, almost from the first, a distinct line between the discolored spot and the green surface of the leaf, as illustrated in figure 3. The margins of the spots are frequently tinged with a reddish brown or purple color. As the spots get older they assume, especially at the centers, an ashy-gray color, due to the development of the fungus and to the formation of spores. Usually the original spots remain distinct, but they often increase in size and number until their destructive influence extends over the entire leaf (figs. 4 and 5), finally causing the seriously affected leaves to die. As the older leaves die off under the influence of leaf-spot, new leaves are formed at the centers of the crowns. The consequence is that the crowns of the infested beets are pushed out, or elongated, as shown in figure 6. The affected spots do not usually break away, leaving holes in the leaf blades, as is the case with some leaf diseases of some other plants, but the leaf often remains intact, even after it is dead from the effect of leaf-spot. The dead leaves usually become more or less brittle, especially if the atmosphere surrounding them is dry, and then the action of the wind, the cultivator, or other agencies may break or tear them (figs. 4 and 5). Frequently, however, the leaves, dead from the effect of this fungus, remain whole, droop, and lie flat on the ground, remaining attached to the plant even until the beets are harvested (fig. 7). At harvest time, however, the diseased leaves become more or less broken, so that portions of disease-infected leaves fall on the ground, where they remain over winter. A beet badly infested with leaf-spot shows, therefore, an elongated crown with a tuft of small green leaves at the top or center, surrounded by a larger or smaller number of whorls of brown dead leaves, as shown in figure 6.

FIG. 4.—A leaf of a sugar-beet plant, showing leaf-spot on both the petiole and the blade. (About one-third natural size.)

In point of time, leaf-spot does not usually appear until midsummer. It may appear, however, at any time after the beets are a few weeks old until the approach of autumn, when the cool nights are unfavorable for the development of the fungus.

The greenhouse and field experiments and observations carried on by the writer since 1901 lead to the conclusion that if the Cercospora spores are present, the spots appear on the leaves within a few days after the plant and weather conditions are suitable for their development. It should also be noted that late plantings of beets are usually very much less liable to severe attacks of leaf-spot than early plantings in the same locality. This condition has undoubtedly been observed by all who have followed the development of leaf-spot in the field during a growing season.

THE LEAF-SPOT FUNGUS.

In order to understand how the leaf-spot organism reproduces itself and how it spreads from plant to plant and from place to place, a brief description of the fungus is here given.

The fungus *Cercospora beticola*, which produces the leaf-spot of the sugar beet, is composed of two parts—the vegetative part, which corresponds in a way to the vegetative part (root, leaves, and stems) of higher plants, and the reproducing bodies, called spores, which, for reproductive purposes, take the place of the seeds of higher plants. The spores are minute bodies, somewhat needle shaped, which are divided into from two to seven cells by means of cross walls, as shown in figure 8. These spores, which are usually light in color, are easily brushed off the surfaces of the leaves on which they are produced and are readily scattered by the wind or other agencies.

FIG. 5.—A leaf of a sugar-beet plant which has been entirely killed by leaf-spot. (About one-third natural size.)

When the spores germinate, they push out colorless tubes from one or several of the spore cells. These outgrowths from the cells of the spores, which are the beginnings of the vegetative parts of the fungus, elongate rapidly, forming threadlike structures. The growing tips of the fungous threads remain colorless, but the older cells become darker and darker until they are brown or black. These threads push out new branches, which in turn elongate, divide into cells, and push out still other branches. These processes are repeated until a network of fine threads has formed, constituting the vegetative body of the fungus. While this growth is going on, the fungus must feed upon soluble material which is absorbed from the beet leaves through the walls of the fungous threads. The tendency of these threads is to push out in all directions at a nearly uniform rate if unobstructed, thus forming round or nearly round spots or areas of growth, as shown in figure 3. As these areas of growth in the leaf become larger, they sometimes become irregular in shape, owing to the presence of the leaf veins or other obstructions which prevent or retard the growth of the fungus in certain directions.

FIG. 6.—A sugar-beet plant showing elongation of the crown due to leaf-spot. (About one-fourth natural size.)

When a spore germinates upon the surface of a beet leaf, the threads produced penetrate the surface of the leaf and push their way among the cells of the leaf tissue, drawing nourishment from the living leaf cells and causing their death. The brown color of the diseased spots on the leaves is due in part to the dead brown cells of the leaf and in part to the color of the older fungous cells.

The main limiting factors in the growth of the fungus are food supply, moisture, and temperature. When the fungous spores lodge upon a beet leaf and the conditions for the growth of the fungus are favorable, the spores soon germinate and produce new spots, upon the surface of which a new crop of spores may be formed. In this manner the life cycle of the fungus is repeated over and over during the growing season, or until the climatic conditions render the reproduction and propagation of the fungus impossible. The length of a single life cycle depends upon the favorable or unfavorable condition of the limiting factors mentioned. For example, with the approach of autumn and the consequent reduction in temperature, the cycles become longer and longer and the infections less and less numerous, until finally they cease.

DISTRIBUTION OF LEAF-SPOT.

Although there are certain localities where leaf-spot has not yet become sufficiently general and severe to do any appreciable damage

FIG. 7.—A field of sugar beets, showing the effect of spraying with Bordeaux mixture. The rows at the left of the stake were sprayed; those on the right were not sprayed. (Examine with magnifying glass, if possible.)

to the sugar-beet crop, there are other localities where the fungus has found apparently very favorable conditions for its growth and development. This is especially noticeable in some parts of the semiarid region as well as in the more humid portion of the sugar-beet belt in the United States. The indications are that it is only a question of time when leaf-spot will be one of the factors to be reckoned with everywhere in the profitable production of this crop, unless practical means for its control are employed. When leaf-spot has become general in the beet fields in a given locality it remains year after year, doing sometimes more, sometimes less, damage, depending upon the climatic conditions and the cultural methods which affect the propagation and development of the fungus. Even if it were possible to eradicate leaf-spot from all sugar-beet fields in this country, it would probably be a question only of time when it would reappear, on account of the wide distribution of the fungus and its probable ability to exist on other host plants, both wild and cultivated, unless the use of practical, inexpensive control methods are continued. In the control of leaf-spot it is therefore important that attention be given to the methods and agencies by which the fungus and its spores are spread, as well as to the elimination of the fungus where the disease already exists.

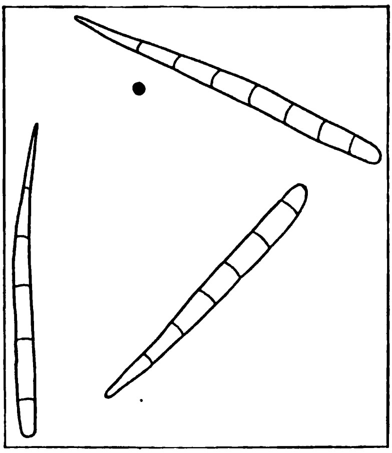

FIG. 8.—Spores of the leaf-spot fungus (*Cercospora beticola*) from sugar-beet leaves. August 20, 1912. (Greatly enlarged.)

The agencies instrumental in distributing Cercospora are numerous and varied in character, chief among which may be mentioned wind, water, insects, and man and other animals. These agencies may act independently, or two or more of them may work together. The distribution of the fungus from leaf to leaf on the same plant or from one beet to an adjacent plant may be accomplished by simple contact or by the action of the wind, the rain, or any of the other agencies mentioned. As already pointed out, the spores readily become dislodged from the mother fungus, and may easily be carried short distances by the wind. The indications are, however, that the spores are not carried long distances in this manner, although bits of diseased leaves may be blown from field to field. Water, especially when used for irrigating purposes, is an important agent in distributing leaf-spot from plant to plant and from field to field. Insects are also active agents in carrying the disease short distances, but man and other animals are apparently the most effective agents in the distribution of leaf-spot. When diseased beets are cultivated, the spores become dislodged by the action of the cultivator or the horses' feet, and the spores may be blown about by the wind or carried on the implement, on the horses' feet, or on the driver's clothing. Careless handling of the diseased beet tops in using them for feed has evidently spread the leaf-spot from field to field in many cases.

The spread of leaf-spot to distant localities not before used for sugar-beet production has generally been attributed to the presence of Cercospora spores on the seed. The fact that seed beets as well as factory beets may be and often are infested with leaf-spot would apparently make it comparatively easy for the spores to find their way to the seed balls, the rough coats of which might hold the spores during the process of transportation and until the seed is planted. While our investigations in this connection indicate that this is not the principal means by which leaf-spot is spread, it is sufficiently probable to warrant consideration in a study of cultural methods. At any rate, it has been found that in new sugar-beet localities, where the conditions are favorable for the growth of the fungus, the beet plants are sooner or later attacked by the disease. It is important, therefore, that control methods shall be practical and effective in places where the fungus exists. While every possible precaution should be taken to prevent the spread of the disease, it is reasonably certain that its elimination can not be accomplished or its appearance in new localities prevented by controlling its possible distribution on the seed. This is evident in view of the fact that the fungus attacks the garden beet, the stock beet, and other plants, both wild and cultivated.

EFFECT OF LEAF-SPOT.

The injurious effect of leaf-spot upon the sugar beet is fourfold. It reduces the tonnage, impairs the quality of the roots, increases the tare, and reduces the feeding value of the leaves. The amount of damage done by leaf-spot in a given field during any season will depend (1) upon the severity of the outbreak, (2) upon the time in the life of the plant that the disease appears, and (3) upon the subsequent weather conditions. Leaf-spot usually appears when a hot, dry period of two weeks or more is followed by moisture accompanied by continued high temperature, provided, of course, the leaf-spot fungus is present in the field. If these conditions prevail, so that the disease appears abundantly within six or eight weeks after planting, the growth of the beets will be retarded and a marked reduction in the tonnage will result. Under these conditions the amount of loss in tonnage will depend upon the subsequent weather conditions, as they may or may not favor the rapid development of the fungus. The more rapid the development of the fungus the greater the injury to the foliage, and consequently the greater the retardation in the growth of the roots and the consequent loss in tonnage. If, however, the disease does not appear until late in the growing season—that is, from three to four weeks before the beets are harvested—the loss in tonnage from the effects of leaf-spot will be slight. The reverse is true in regard to the effect of leaf-spot upon the sugar content of the beets. While the beet begins to store some sugar very early in its existence, the rapidity of storage increases with the age of the beet. If, therefore, leaf-spot appears early, is severe for a time, and then by some means is retarded in its development during the latter part of the growing season, the sugar content of the beets may reach a normal or nearly normal percentage. The yield of sugar per acre under these conditions will be reduced only because of the smaller size of the beet roots. On the other hand, if the disease appears late in the growing season and continues its injury to the foliage until the beets are mature, there will be a marked decrease in the sugar content of the beets and a corresponding loss in the sugar per acre, although the tonnage may not be appreciably lessened. If the fungus begins its destruction of the foliage early and continues it until late in the growing season, there will be a loss in both tonnage and sugar content of the beets. Hence, leaf-spot may reduce the tonnage only, it may reduce the sugar content only, or it may, and usually does, reduce both the tonnage and the sugar content of the beets. It has been found by the writer and others that a limited amount of injury may be done to the beet foliage with no appreciable effect upon the size or quality of the roots. It is possible, therefore, to have such a light attack of leaf-spot that no appreciable injury results, but if the attack of Cercospora is severe enough to be at all injurious it will reduce the amount of sugar per acre.

The effect of the disease upon crown development is very marked. As has already been noted, it is the older and therefore the outer whorls of leaves that are first attacked by leaf-spot, while the young leaves in the center of the crown usually remain in a healthy, growing condition. When the older leaves die under the influence of leaf-spot, the crown of the beet is drawn out or elongated, as shown in figure 6. Inasmuch as the beet crown contains a high percentage of salts taken up from the soil, which tend to keep the sugar from crystallizing in the mill, all beet-sugar companies require that the crowns be cut off at the point of the lowest leaf scar. When the crowns are unduly elongated the result is a heavy tare upon the beet crop, since a large amount of growth has gone into the elongated crown instead of into the root proper. This is not an entire loss, since the beet crowns, together with the leaves, form an excellent stock feed. But since sugar beets are grown primarily for the money value of the root proper, the undue elongation of the crowns causes considerable money loss to the grower. The amount of elongation and consequent loss due to leaf-spot depends upon the severity of the attack and upon the time in the growth of the plant that the disease appears.

As already stated, beet tops—that is, the crowns and leaves together—form a very important stock feed. In connection with other foods, beet tops form one of the most valuable stock feeds produced on the beet farm, especially for dairy cows. Any injury, therefore, that tends to decrease the quantity or to reduce the quality of this material is a serious loss to the beet grower. While leaf-spot tends to elongate the crown and thereby to increase the percentage of crown compared with the root yield per acre, the total quantity of feed produced from badly or even moderately infested beets is very greatly lessened by the effects of leaf-spot. Aside from the effect that leaf-spot has upon crowns, the leaves are rendered brittle and frequently die before they are mature. As a result of the brittleness of the leaves they are more or less seriously broken in handling at harvest time, with the result that a large part of the diseased leaf material remains in the field and is lost, so far as feeding it to stock is concerned. As to their feeding value, it is safe to say that the injured leaves have lost at least 50 per cent of their value. This is a source of loss that is frequently overlooked, but it is none the less important. Estimating the feeding value of vigorous beet tops at $5 per acre, which is below their real value, the total value of the tops in this country would be, for the 635,100 acres harvested in 1913, $3,175,300. An average loss of even 10 per cent of the feeding value of the tops due to leaf-spot would amount to over $300,000, to say nothing of the greater loss occasioned by the reduction in the tonnage and in the sugar content of the roots.

CULTURAL METHODS OF CONTROL.

The most satisfactory and profitable methods known at present for controlling leaf-spot are deep fall plowing and crop rotation. Inasmuch as crop rotation is the "balance wheel" of good farming and must be practiced in order to obtain the most profitable results, regardless of the presence of leaf-spot, this disease and many other pests may be controlled and other advantages gained by crop rotation without extra expense and labor. If the rotation system is wisely planned and carefully and thoroughly executed, better crops of all kinds will result and many pests, including this fungus, will be eliminated or at least reduced below the point of serious injury.

The principles of disease control by means of crop rotation are based upon the fact that certain pests, like this fungus, can thrive only on certain kinds of plants. Therefore, when the crops are changed and the food supply thereby cut off, the pests must perish or be greatly reduced in number. It must be remembered that the most profitable crop rotation does not consist merely in changing the crops around from year to year regardless of the relation of the crops to each other, but that the central aim in all crop-rotation systems should be to leave each field in better tilth, better physical condition, and reasonably free from pests at the end of each rotation cycle.

No hard and fast rotation system can be laid down for any community, but the most profitable system must be worked out for each farm and, indeed, for each field. There are certain general principles, however, that should be borne in mind in this connection in order to accomplish the most satisfactory results. For soil improvement there should be at least one leguminous crop in each rotation cycle. To this class of plants belong the clovers, alfalfa, peas, beans, etc. There should be also a sufficient quantity of live stock, especially milch cows, on each farm to utilize the beet tops and roughage and to supply the desired quantity of stable manure, which, in addition to green crops plowed under, will furnish the necessary amount of humus to the soil. The conditions resulting from this treatment, if the soil is properly handled, will make the succeeding crops more vigorous and capable of offsetting, in some measure at least, the effects of any pests that may appear. Again, the successive crops in any rotation should be so selected and arranged that no two upon which the same pest may thrive will be grown in succession. The beet-leaf fungus *Cercospora beticola* has not been known to thrive upon the small grains, corn, clover, alfalfa, cowpeas, beans, and many other plants suitable for rotation with sugar beets. It is apparent, therefore, that crop rotation properly carried out offers a satisfactory means of eliminating, or at least of keeping in check, this pest, which, if allowed to gain headway, will turn an otherwise profitable crop of sugar beets into a serious loss to the grower. Experience and observation teach that not more than two successive crops of beets should be grown in any rotation cycle. It is true that three or more successful crops of beets have been grown in succession in some instances, but for obvious reasons it is a bad practice and should be avoided. Many successful growers never follow beets with beets. In one locality where leaf-spot had formerly been a serious pest, a system of crop rotation has been adopted in which beets seldom follow beets, with the result that leaf-spot is no longer feared. An examination of the beet fields in that locality late in the growing season showed practically no leaf-spot in any of the fields where a few years before a field not more or less seriously injured by leaf-spot was an exception.

The length of time that a field infested with leaf-spot should be in crops other than beets in order to insure the destruction of the leaf-spot fungus and spores appears to depend somewhat upon climatic conditions and upon the manner in which the soil is handled. One field that came under the writer's observation was so badly infested with leaf-spot that the crop was not harvested. The field was then seeded to alfalfa. At the end of two years it was fall plowed to a depth of 12 to 14 inches and subsequently put into beets for two successive years. Very little leaf-spot appeared either the first or second year that the field was in beets, following the two years in alfalfa. This and other examples indicate that, under some conditions at least, an interval of two years will reduce leaf-spot below the danger point. It is wise, therefore, in planning a rotation cycle to arrange for two or more years in other crops before returning to beets. Furthermore, it should be noted that the best all-around results are obtained when the rotation period covers three or more years.

Another method which has given positive results in the control of beet leaf-spot is that of deep fall plowing. The writer has found by experience that deep fall plowing of beet land has a marked effect in reducing the amount of leaf-spot in the succeeding crop. For example, a field where leaf-spot was very injurious to the beet crop was plowed to the depth of 14 inches in November. It was again planted to beets the following year, with the result that very little leaf-spot appeared, while the shallow-plowed land in the same locality which was planted to beets showed a destructive amount of leaf-spot. On general principles of good farming an occasional deep fall plowing is beneficial to certain soil. It is not to be recommended, however, as a general method of controlling leaf-spot, to the exclusion of crop rotation, and should be used for this purpose only in case it is absolutely necessary to follow infested beets with another crop of beets.

SUPPLEMENTAL AIDS IN THE CONTROL OF LEAF-SPOT.

SPRAYING.

The cost of spraying, together with the extra labor involved and the possible lack of thoroughness in the work, makes it questionable whether spraying should be considered as a control measure for leaf-spot. However, there may be conditions under which spraying would be advantageous. It has, therefore, been considered best to refer to this method in this connection. The writer has demonstrated repeatedly that leaf-spot may be controlled almost perfectly by the proper use of Bordeaux mixture. The most important question in this connection is whether the cost of spraying will exceed the advantages to be gained by this method of control. The formula for Bordeaux mixture used by the writer in his experiments and demonstration work with leaf-spot was 4-4-50; that is, 4 pounds of copper sulphate, commonly called bluestone, 4 pounds of slaked lime, and 50 gallons of water.[1] After ascertaining that this preparation would in no way injure the beet foliage, the next point to determine was the proper and most effective time to begin the spraying. In order to settle this point, a field which had been in beets the preceding year and which was badly infested with leaf-spot was selected, prepared, and planted. A number of plats to be sprayed were then laid off on one side of the field in such manner that the sprayed plats would be bordered on three sides by beets not sprayed. The first plat was sprayed as soon as the beets were thinned and while they had from four to six leaves only. Two weeks later the same plat was sprayed again and another plat of the same size adjacent to the first was sprayed for the first time. After another interval of two weeks the first and second plats were again sprayed. This operation was repeated until leaf-spot began to appear on the unsprayed beets. The last plat added to the experiment had a few spots on the leaves due to *Cercospora beticola* when sprayed for the first time. All the plats that had been sprayed were subsequently resprayed at intervals of two weeks throughout the season; that is, until the nights turned cool and the danger of the spread of the disease was over.

When the spraying was discontinued in the autumn none of the plats that had been sprayed had any perceptible amount of leaf-spot, while the unsprayed beets on the three sides of the sprayed plats were infested to such an extent that from one-half to two-thirds of the leaves of each beet were entirely brown and dead. In the last plat added to the experiment, that is, the one in which the leaves had an occasional tiny Cercospora spot, the disease did not advance, and it was just as good from the standpoint of tonnage and quality at the end of the season as the other plats sprayed, while the unsprayed plats were badly damaged in both tonnage and quality. This experiment was repeated several seasons and always gave similar results, varying only in the amount of damage done by the disease to the unsprayed beets. In some cases the yield of the unsprayed beets was only 50 per cent as great as the yield from an equal area of sprayed beets. This was the result if the disease appeared early and was severe in its attack until past midsummer. In other cases the sugar content of the unsprayed beets was 5 per cent lower than in the sprayed beets. The greatest reduction in sugar content occurred when the pest continued to develop until nearly harvest time, showing that the amount of damage done by leaf-

[1] Bluestone is best dissolved by placing it in a gunny sack and suspending it in a given quantity of water in a wooden tub or barrel. A metal container should not be used. The lime should be stone lime of good quality and freshly slaked. These solutions will keep a long time if they are not mixed. In preparing Bordeaux mixture the two solutions are each diluted and then poured at the same time into a tub or barrel and vigorously stirred. To this mixture enough water should be added so that the proportion of bluestone, lime, and water will be 4 pounds of bluestone and 4 pounds of lime to each 50 gallons of water. It should be used as quickly as possible after it is prepared.

spot depends upon the time that the disease appears and upon the subsequent weather conditions. These experiments prove that leaf-spot may be controlled by the use of Bordeaux mixture and that spraying before leaf-spot appears is a waste of time and material.

The cost of spraying will depend upon local conditions. The price of bluestone is subject to some fluctuations, but it can usually be had in bulk at from 7 to 12 cents per pound. One barrel, or 50 gallons, of the spray containing 4 pounds of bluestone should spray at least one-half acre. At an average cost of 10 cents per pound, the bluestone required for 2 barrels of spray, sufficient for an acre, would be 80 cents. The cost of the lime is so slight that it may be ignored. Two men, a team, and a 4-row sprayer should cover from 5 to 10 acres a day, depending upon the convenience of the water supply

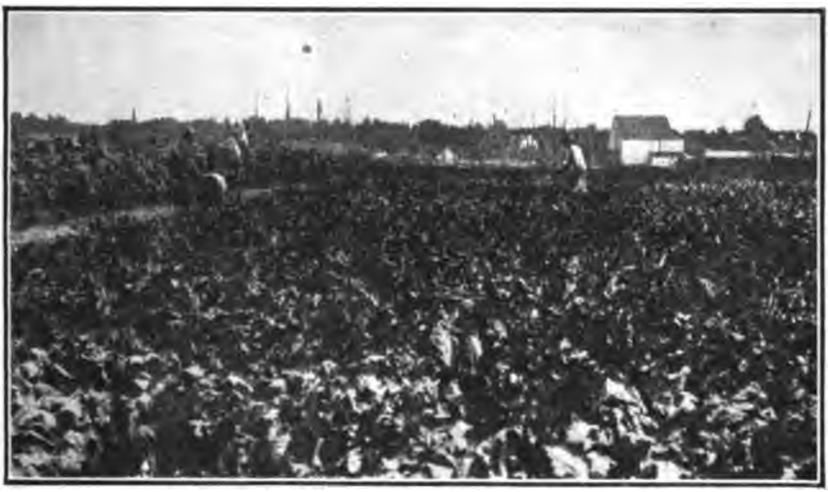

FIG. 9.—A field of sugar beets in 1901, showing the method employed in tests of spraying as a means of controlling leaf-spot.

and the efficiency of the sprayer. The daily labor cost for men and team should not exceed $6. Taking 8 acres as an average day's work, the labor cost per acre should not exceed 75 cents for each spraying. Taking six as the minimum number of sprayings that would be required in any season, the cost per acre for the season would be for bluestone $4.80 and for labor $4.50, making a total of $9.30. At a flat rate of $5 per ton for beets, it would therefore require an increased yield, due to the spraying, of nearly 2 tons per acre to offset the cost of material and labor. Local conditions must determine whether putting this additional expense upon the crop would be justified. It should be added that the spraying to be effective must be thoroughly done (fig. 9). Both the upper and the lower surfaces of the leaves must be completely covered with the mixture. Spraying the upper sides of the leaves only or a partial spraying of both the upper and the lower sides of the leaves will not be effective in controlling leaf-spot. In no case, therefore, should spraying for leaf-spot be undertaken unless it can be done thoroughly and at the proper time.

In certain localities there are difficulties in the way of thorough spraying that should be given due consideration before the work of spraying for leaf-spot is undertaken. For example, in irrigated sections it is sometimes necessary to irrigate the beets just at the time when the spraying should be done to be most effective. Furthermore, the irrigation ditches across the fields are a hindrance to the work. Either the ditches must be plowed in each time before spraying or much time will be lost in turning at each cross ditch. In humid regions these difficulties are not encountered, but in localities where showers are frequent the spray may be washed off by rain before the mixture has had time to dry on the leaves. In such cases respraying is necessary, and should be done immediately after the rain is over. If spraying is undertaken, it must be remembered that it is a preventive and not a cure. For this reason the leaves must be covered as soon as the disease beings to appear, in order to make further infection impossible.

MOISTURE.

A constant and uniform supply of moisture in the soil has a beneficial effect in retarding an outbreak of leaf-spot. Moisture reduces the temperature of the soil and of the atmosphere surrounding the beets and also prevents the leaves from wilting. It is noticeable that a slight reduction in temperature will retard the development of Cercospora and the production of spores. It is noticeable also that when a beet wilts it is generally the outer or older leaves that wilt first, just as it is generally the outer or older leaves that show the first spots. Beets growing close to irrigating ditches and in other places favorable to a constant and uniform water supply are, as a rule, much less severely attacked by leaf-spot than beets growing under conditions which show marked variation in the supply of soil moisture.

As previously noted, severe outbreaks of leaf-spot usually have been preceded by a long dry period followed by a renewal of the moisture supply. The dry period is usually long enough to cause a wilting of the outer beet leaves. While there seems to be some relation between the wilting of the leaves and an outbreak of leaf-spot, the exact connection has not been determined. As a control method, however, it is safe to say that a constant and uniform supply of soil moisture sufficient at all times to prevent the wilting of the leaves will aid in retarding an outbreak of leaf-spot. Every effort should therefore be made to put the soil in the best possible shape for receiving and holding moisture by plowing the ground to a good depth, by supplying an adequate amount of humus, and by frequent and thorough subsequent cultivation.

Under certain conditions, moisture gathering and holding substances, such as common salt, have appeared to be of value in preventing an outbreak of leaf-spot. In some experiments along this line the writer found that 1,000 pounds per acre of common salt applied just before planting and thoroughly worked into the surface soil reduced the severity of leaf-spot to a marked degree, as shown in figure 10. However, this treatment had no decided effect upon leaf-spot if the period of drought preceding the outbreak of the disease was exceptionally long and severe. In irrigated sections frequent waterings will be beneficial in warding off leaf-spot, but unless

FIG. 10.—A field of sugar beets, showing the effect of salt treatment. The ground to the right of the stake was treated with 1,000 pounds of common salt to the acre; the area at the left was not treated.

the physical condition of the soil is such that it has a good water-holding capacity it will be practically impossible to irrigate often enough to prevent the development of the fungus. In fact, frequent waterings with a low water-holding capacity of the soil seem to aid rather than retard the development of leaf-spot.

DISPOSING OF BEET TOPS.

Theoretically, it should be feasible to remove the leaf-spot from a field by carefully gathering and removing the diseased beet leaves; but since the diseased leaves are more or less torn and scattered during the harvesting process, it is practically impossible to accomplish this result. The usual methods practiced in the handling of beet tops are the pasture method, the hauling-off method. and the plowing-under method. Cattle or sheep may be used in pasturing the tops after the roots are removed from the field. This should be done only when the soil is in such condition that it will not be injured by trampling. Care should be taken also that this method does not result in scattering the disease to fields to be used the following year for beets. This can be accomplished by not allowing the stock to enter the fields that are to be used for beets the following year while pasturing on the beet tops or until several days after they have been taken off the beet-top pasture. If the tops are hauled to the feed yard or silo, care should be taken to allow none of the diseased leaves to be scattered on the ground to be used for beets the following year. Beet tops are far too valuable as stock food to be wasted and should be hauled to the feed yard or silo, where they should be properly stored and eventually fed in racks. This is not only economical, but it keeps the diseased leaves from blowing about and puts the manure where it can be handled in the safest manner and to the best advantage. Beet tops, if plowed under, will add some humus to the soil. Under some local conditions this may be the best method of disposing of the tops. If this method is used, the plowing should be done in the fall in a thorough manner, so that all the leaves will be turned under to a depth of 10 inches or more.

DISPOSING OF THE MANURE.

It has been found that the beet-leaf fungus will be destroyed in one or two years if beets are not grown in the field where it is present or if the infested ground is deeply plowed in the fall. It becomes a simple matter, therefore, to prevent the propagation of the leaf-spot fungus by applying the manure to the land one or two years in advance of the beet crop. This is not only a wise precaution from the standpoint of controlling leaf-spot, but it is also good farming, since sugar beets do much better on well-manured ground to which the manure was applied one or two years in advance of the beet crop.

SUMMARY.

(1) *Leaf-spot may be controlled on a commercial scale and in a practical and inexpensive manner by a carefully planned and thoroughly executed system of crop rotations or by deep fall plowing. The best results are obtained by combining these two methods.*

(2) A proper and uniform supply of soil moisture, spraying, and the proper disposition of beet tops and stable manure are important aids in the control of leaf-spot.

(3) The principal agencies in the distribution of the leaf-spot fungus are wind, water, insects, and man and other animals.

(4) Leaf-spot tends to reduce either the tonnage or the sugar content of the beet, or both, depending upon the time, duration, and severity of the attack.

(5) Leaf-spot seriously injures the feeding value of beet tops.

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619
Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.
November 16, 1914.

BREEDS OF DRAFT HORSES.

By G. Arthur Bell,
Senior Animal Husbandman, Animal Husbandry Division.

INTRODUCTION.

The purpose of this publication is to present to the reader in a concise manner the most important features regarding the breeds of

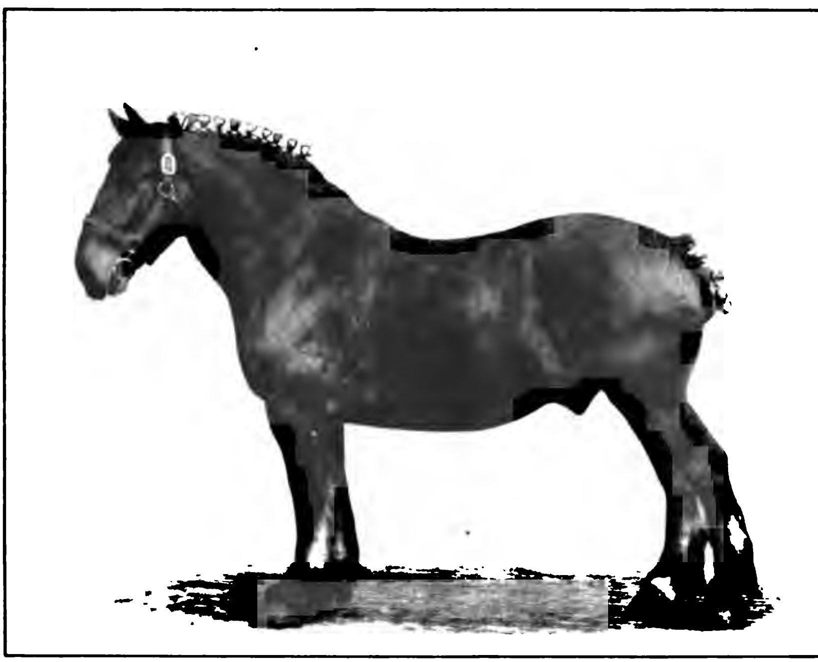

Fig. 1.—Draft gelding, an excellent type, combining a massive form with good underpinning to an unusual degree.

draft horses in this country. A history of the breeds or information regarding the early types has been purposely avoided, and the reader

Note.—The respective characteristics and desirable qualities of the several breeds of draft horses in this country are presented in this bulletin.

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who desires information on such matters is referred to the list of books given at the end of this paper. The name and address of the secretary of the pedigree-record society for each breed is given at the conclusion of the portion dealing with that particular breed, and the reader is referred to the various societies for information regarding the rules of registry and the issuance of studbooks, or for lists of breeders.

POINTS OF THE DRAFT HORSE.

The draft type is characterized by massiveness, and the particular field for this type is the hauling of heavy loads at a comparatively slow gait, usually at the walk. Therefore power and not speed is desired, and in order to possess this power the horse should be generally blocky or compact, low-set or short-legged, and be sufficiently heavy to enable him to throw the necessary weight into the collar to move the heavy load and at the same time maintain a secure footing. In fair condition a drafter should weigh not less than 1,600 pounds, and the majority will be between 16 and 17 hands in height, but, of course, many are found below and above these heights. In some localities horses weighing less than 1,600 pounds are termed drafters, but in localities where the heavy draft horse is common they would not be classed as such, unless designated as light drafters.

In the typical drafter the head is comparatively lean, wide between the eyes, and in size proportioned to the body. The eye is bright and fairly prominent. The neck is strong and muscular, of fair length, and somewhat arched; in the stallion it is well arched or crested, in the gelding or mare less so. The shoulders are shorter and more upright than in the case of the light horse, and a happy medium between the straight and sloping shoulder gives the best combination of power and movement. Too straight a shoulder causes excessive concussion, and the result is bone and tendon trouble in the feet and legs. On the other hand, too sloping a shoulder renders it difficult to fit the heavy collars properly. In the draft horse, however, the former is much more common than the latter.

The chest is deep and comparatively broad, thus providing plenty of room for the lungs. The girth, or the body's circumference behind the forelegs, is large, and horses slack in that region are usually weak in constitution. The body is broad, deep, and comparatively short; the back is short and broad, and the ribs well sprung, giving a round appearance to the body. The horse with a shallow body is usually a poor feeder. The loin is broad and well muscled; the croup is fairly level, long, broad, and well muscled. A short, decidedly sloping croup is not so well muscled as the straighter and longer one. The hindquarters and thighs are well muscled, and it is from the hindquarters that the horse obtains most of its propelling power, the front legs acting largely as weight carriers.

Good underpinning, consisting of good legs and feet, is essential. Good, clean, heavy bone is necessary in order to afford attachments for the heavy muscles and to stand the heavy wear and tear. The cannon bones are the best indication of the bone throughout. In this region the bone should feel firm, and the tendons should stand out distinctly from the bone, giving the cannon bones when viewed from the side a wide, flat appearance. The knee should be broad and deep when viewed from the front. The hock should be broad from front to back, and of strong structure. The pasterns should be fairly long and sloping. While some draft horses possess too long and too sloping pasterns, a much larger number have too short and too straight pasterns. The foot should be fairly large and the horn of the hoof dense. The dark-colored hoofs are the most popular, as it is thought they denote greater durability. In the draft horse as much quality as is consistent with the required substance is desirable, but quality should not be obtained at the sacrifice of too much weight.

In temperament the draft horse is generally lymphatic, but he should not be too sluggish. While the nature of his work requires him to be steady and easily managed, it is nevertheless essential that it should be performed willingly and with some snap and vigor.

The draft-horse gait is the walk. The stride should be rapid and of good length, and the feet should be carried straight forward. This kind of action renders possible the covering of considerable ground in the least possible time. While the walk is the normal gait, the ability to trot well is desirable. Often faults not noticeable at the walk are brought out at the trot.

BELGIAN.

The Belgian draft horse, as the name indicates, originated and has been developed in Belgium, and is the only breed of horses which is bred to any extent in that country, the light horses used in Belgium being purchased largely in other countries. In 1886 the Belgian Draft Horse Society was organized for the purpose of encouraging the breeding of the native draft horse and to maintain a studbook for the breed. In June of each year the annual show of this society is held at Brussels. At the twenty-eighth annual show, held in June, 1913, the entries totaled more than 1,000, and this is probably the largest show of a single breed of horses held in the world. The breeding of Belgian draft horses is also promoted by the Government, which annually awards prizes and subsidies to the best animals in the various provinces. Stallions which stand for public service must be approved by a commission appointed by the Government.

Importations of these horses into the United States occurred more or less frequently during the last half of the nineteenth century, but it has been only within the past 10 years that they have been imported in any large numbers. The early trade was principally a stallion trade, but during the past five years quite a large number of mares have been imported.

The Belgian divides honors with the Shire as being the heaviest of any of our breeds. Mature stallions in fair condition, weighing a ton or more, are comparatively common. In height mature stallions

FIG. 2.—Belgian stallion.

will probably average slightly over 16¼ hands, and mature mares about 16 hands. In general conformation they are the most compact of any breed, the bodies being short, wide, and deep. The head is of medium size, the neck is short and heavily crested or arched, the chest is broad and deep, the back is short and well muscled over the loin, the croup is somewhat drooping or steep, and the quarters are full and heavily muscled. The legs are short and free from the long hair or feather characteristic of the Clydesdale and Shire. In action the Belgian is good, but is less active than the Clydesdale or

Percheron. In temperament he is docile and easily handled. He is a good feeder, is rated as an easy keeper, and stands shipment well. The colors common to the Belgian are bay, chestnut, and roan, but browns, grays, and blacks are occasionally seen.

Some of the criticisms of the Belgian horse are that a large number have necks that are too short and heavy, too drooping a croup, a roughness about the hocks, bone that is not sufficiently flat, too short and straight in the pastern, hoof deficient in circumference, and a lack of general quality; but great improvement has been noted

FIG. 3.—Belgian mare.

in respect to these deficiencies in recent years. The extreme width may cause the Belgian to roll somewhat at the walk, but as a class they are good movers at the trot.

In this country the Belgian sire has been valuable in improving the draft conformation of our horse stock, particularly when mated with many of our rangy, loosely coupled mares. The breed has made wonderful progress in this country, considering that it has attracted much attention only during the past 10 or 15 years. In fact, probably no breed has shown a greater increase in popularity and a greater improvement during the past decade.

The distribution of the Belgian draft horse in the United States is widespread, but it is found in the greatest number in those sections where the heaviest type of draft horse is most prevalent, such as the Central West, particularly in Indiana, Iowa, Illinois, Ohio, and Nebraska.

The American Association of Importers and Breeders of Belgian Draft Horses was organized in 1887, but the first volume of that association's studbook was not published until 1905. To date, however, five volumes have been issued, the fifth having been issued in 1913. Up to January 1, 1914, more than 8,000 stallions and nearly 4,000

FIG. 4.—Percheron stallion.

mares had been recorded. The secretary of the association is J. D. Conner, jr., Wabash, Ind.

PERCHERON.

The Percheron originated in France and has been developed in a small district in the northwestern part of that country known as Perche. This district is about one-fifteenth the size of the State of Iowa, and only Percherons born within its boundaries are eligible to registry in the Percheron Studbook of France. Percheron foals, to be accepted for registry in the French book, must be registered during the year of their birth. Prior to such registration they must be examined by an official appointed by the Percheron Horse Society of France, who takes a careful description of their color and markings, and who brands them on the neck with the letters "S. P." enlaced.

The Percheron Horse Society of France was organized in 1883, and in addition to looking after the registration of Percherons it holds an annual summer show in the Percheron district. The society also offers prizes at other shows. The improvement of the Percheron and other breeds in France is due to both public and private efforts. The Government has for a number of years maintained studs in

FIG. 5.—American-bred Percheron mare.

which selected animals have been kept for breeding purposes. In addition, subsidies are granted to private individuals in order to keep high-class horses in the stud. Stallions intended to stand for public service in France must be examined by officials appointed by the Government and certified as being free from periodic ophthalmia, or moonblindness, and roaring (thick wind).

The introduction of Percheron horses into the United States dates back many years. One of the early stallions brought to this country which exerted considerable influence on our draft stock was Louis Napoleon, imported in 1851 by an Ohio firm. Other Percherons were imported about this time and during succeeding years.

During the early seventies they were imported in quite large numbers, and these importations have continued to date.

The head of the Percheron is clean-cut, of medium size, and more refinement is noticed about the head and neck of the Percheron than of any other draft breed. The neck is rather short and well crested. The chest is deep and broad, the back is short, the loins smooth and well muscled. The croup is wide, and on the average is somewhat more sloping than is considered desirable, but great improvement in this respect has been made in recent years. The legs, feet, and bone are on the average good. The legs are free from the long hair or feather characteristic of the Clydesdale and Shire. In action the Percheron is good at both the trot and the walk, and the trot is characterized by a snap and boldness not ordinarily displayed by the other draft breeds. This breed may be regarded as one of the best movers and is surpassed in style of action only by the Clydesdale.

The Percheron is not so large a horse as either the Belgian or the Shire, but as a class will probably outweigh the Clydesdale slightly. Good, mature stallions in fair condition will usually weigh from 1,800 to 2,000 pounds, and there are many which weigh considerably over 2,000 pounds. In height good, mature stallions will measure 16 to 17 hands, with a general average of about 16½ hands, but of course there are some under and a few over these heights, although the rangy, tall Percheron is not in demand in this country. The popular Percheron is rather short-legged, compact, and blocky in form, less so than the Belgian, but more so than the Clydesdale or even the Shire.

The colors common to the Percheron are black and gray, although bays, browns, chestnuts, and roans are occasionally seen. It may be safely stated, however, that 90 per cent of our Percherons are either black or gray.

While occasionally difficulty may be experienced in deciding whether an animal is a Percheron or a Belgian, the two types are quite distinct. The Belgian is heavier bodied, more compact, shorter legged, and his head is more square in outline; the neck is shorter, more heavily muscled, and more heavily crested. Moreover, the colors common to the Belgian—namely, bay, chestnut, and roan—are uncommon to the Percheron, while the gray and black colors common to the latter are uncommon in the Belgian.

Some Percherons are criticized as having croups too sloping or steep, with the tail set too low. Others are criticized as being too fine—not sufficiently drafty—having a lack of depth and fullness of body. Other faults which are sometimes seen are cannon bones which are rather round, lacking in breadth and flatness, lack of bone for the size of the body, and pasterns which are too short and straight.

The distribution of the Percheron horse in this country is widespread, and for years he has been the favorite drafter of the American people. In the United States to-day Percherons outnumber all other draft breeds combined, and there does not appear to be any diminution in their popularity. This probably is due in part to the good start given the breed by the pioneer importers and breeders, but this popularity must be attributed to some extent, at least, to their general adaptability to meet the needs and desires of the American people. For crossing on ordinary mares the Percheron stallion has been very popular, so that grade Percherons are very common, and are great favorites in our horse markets.

In 1876 the National Association of Importers and Breeders of Percheron-Norman Horses was organized. The Percheron Society of America is an outgrowth of that association. The sixteenth volume of the studbook of this society was issued in 1914. Up to January 1, 1914, over 100,000 animals had been accepted for registration. The secretary of the Percheron Society of America is Wayne Dinsmore, Union Stock Yards, Chicago, Ill.

FRENCH DRAFT.

The name "French Draft" is applied broadly to all the breeds of draft horses in France, including the Percheron. In addition to the Percheron, there are a number of other draft breeds in France, such as the Boulonnais, Nivernais, and others. Of these, the Percheron is by far the best known, and has obtained a foothold in this country much greater than that of any other French breed of draft horses. Of the other breeds, the Boulonnais and Nivernais are the only ones of any particular interest in this country.

The Boulonnais is found in northern France in the vicinity of Boulogne. This breed is probably a trifle larger than the Percheron and somewhat coarser, but in general type resembles the Percheron quite closely. The color common to the Boulonnais is gray, but occasionally other colors are seen. This breed has been imported in larger numbers than the Nivernais.

The home of the Nivernais is in central France, in the Department of Nievre. In type it is quite similar to the Percheron. The color is black.

The National French Draft Horse Association of America publishes a studbook, in which may be registered any of the French Draft breeds or their crosses. The association was organized in 1876, under the name of the National Norman Horse Association, but the name was changed in 1884 to the National French Draft Horse Association. Twelve volumes of the studbook have been published, containing the registrations of 23,000 animals. The secretary of this association is C. E. Stubbs, Fairfield, Iowa.

CLYDESDALE.

The Clydesdale originated and has been developed in Scotland, and is practically the only draft horse found in that country. The breed is of mixed origin, and the early history is more or less obscure. It is probable that the blood of both Flemish and English horses entered quite largely into the breed during its early history. For a number of years, however, the Clydesdale has been bred pure. In 1878 the Clydesdale Horse Society of Great Britain and Ireland was organized.

FIG. 6.—Clydesdale stallion.

The first Clydesdales brought to North America were probably imported into Canada by the Scotch who had settled there. In the early seventies Clydesdales were imported into this country both through Canada and by direct importation. By 1880 they were being imported in large numbers, and these importations continued for several years. During the past 10 years the number of Clydesdales imported has averaged slightly less than 100 per annum.

The Clydesdale is not as heavy as either the Belgian or the Shire, and probably, as a class, will not weigh quite as much as the Percheron. The Clydesdale is more rangy and lacks the width and compactness of the breeds mentioned. The Scotch breeders have paid particular attention to legs, pasterns, and feet, but have placed less emphasis on weight than has been the case in other breeds. Average mature Clydesdale stallions in this country will probably weigh 1,700 to 1,900 pounds when in fair condition, with an average height of nearly 16¾ hands. Mature mares will probably weigh 1,600 to 1,800 pounds and average about 16 hands in height.

No other draft breed equals the Clydesdale in style and action. The prompt walk with a good, snappy stride, and a sharp trot with hocks well flexed and carried close together are characteristic of this breed. Good clean, flat bone; well-set, fairly long and sloping

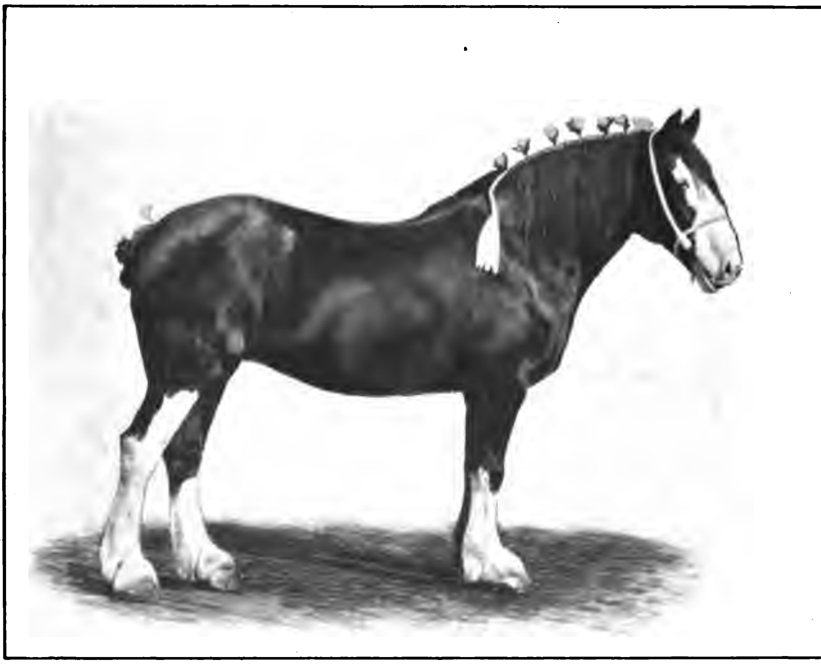

FIG. 7.—Clydesdale mare.

pasterns; and a moderate amount of fine feather or long hair at the rear of the legs below the knees and hocks are important and characteristic features. The colors most common are bay and brown with white markings, but blacks, grays, chestnuts, and roans are occasionally seen. The white markings are characteristic, and it is the exception to see a bay or brown Clydesdale without a white face and considerable white on the feet and legs.

Some of the criticisms of this breed have been the lack of size of body, lack of width and depth, too much feather, and too much white with no regularity of distribution. The average American does not like a horse decorated with a white face and legs. Nor has the feather been popular with Americans, owing to the care necessary to keep the feet and legs clean. This, of course, is not so objectionable in countries where most of the roads are macadamized.

It is not always easy to differentiate between Clydesdales and Shires, but taking the breeds as a whole they are quite distinct. The Clydesdale is not as heavy bodied as the Shire, has more refinement, and the feather is somewhat more silky or finer and less abundant than in the Shire.

In this country Clydesdale geldings have been quite popular in the cities for use by those who want draft horses with a good, long, snappy stride, and at the same time possessing style and action. Our native mares of draft character bred to Clydesdale stallions have produced many excellent animals. They often lack the weight necessary for the heaviest work, but are horses of medium draft weight and are active at both the walk and the trot.

The distribution of the Clydesdale in this country is quite widespread throughout the northern half; the breed is seldom found, however, in the South. It has found the most favor in such States as Iowa, Illinois, Wisconsin, Minnesota, and the Dakotas.

The American Clydesdale Association was organized in 1879, and has issued 16 volumes of the American Clydesdale Studbook, containing the registrations of 16,000 animals. The secretary of this association is R. B. Ogilvie, Union Stock Yards, Chicago, Ill.

SHIRE.

The Shire originated and was developed in England, and to-day is bred in all sections of that country. The real origin of this breed is more or less speculative. It is known that this type of draft horse existed in England in early times. It is probable that the early Shire was of very mixed breeding, but at the present time the Shire is bred very pure. In 1878 the Shire horse breeders of England were organized under the name of the English Cart Horse Society. In 1884 the name was changed to the Shire Horse Society. In addition to the registration of horses, the society holds an annual show and sale in London, and also awards medals and prizes at the leading agricultural shows in England and at some of the fairs and expositions in the United States.

Shires were imported into this country a good many years ago. Mr. George E. Brown, in volume 1 of the American Shire Horse Studbook, states that in 1853 a Mr. Strickland imported a stallion direct from England to Aurora, Ill., where the horse was known as John Bull. Volume 1 of this studbook shows the registration of a small number of stallions imported in 1880, and these importations increased until in 1887 more than 400 Shires were imported.

The Shire is a massive horse, with a wide, deep, and long body, and is equaled in weight only by the Belgian. Shire stallions in fair condition weighing 2,000 pounds or over are comparatively common. They are less compact, or more rangy, than the Belgian, and in height will average taller than any other draft breed. Stallions standing 17 hands or more in height are quite common; in fact, probably the average height of mature Shire stallions in this country is close to 17 hands. Mature Shire mares will average about 16¼ hands in height and will, in fair condition, average about 1,800

FIG. 8.—Shire stallion.

pounds in weight. Heavy bone and feather are characteristic of this breed. In temperament the Shire is probably more lymphatic than any of our other breeds, and therefore less active than is desired by many. The common colors are bay and brown, with white markings, although blacks, grays, chestnuts, and roans are occasionally seen.

This breed is criticized for lack of quality and refinement in general, a sluggish temperament, the abundance of feather, and the large amount of white. From the American standpoint the abundant feather is objectionable, owing to the difficulty of keeping the legs clean.

While many Shires and Clydesdales are so similar as to render it difficult at times to distinguish the one from the other, the two types are quite distinct. The Shire is more massive, heavier bodied throughout, and the feather or long hair on the legs is more abundant and coarser than that of the Clydesdale.

The distribution of the Shire throughout the northern half of this country is quite widespread, but, like the Clydesdale, it is seldom found in our Southern States. This breed has met with the most favor in the Central West, particularly in Illinois, Iowa, Indiana, and Nebraska; it is also popular on the Pacific coast in the States of

FIG. 9.—Shire mare.

Washington, Oregon, and California. A great many of our best market geldings possess some Shire blood; and where height as well as bone and substance is desired, it can be derived from Shire blood with greater certainty than from other breeds.

The American Shire Horse Association was organized in 1885, and has issued eight volumes of its studbook and recorded over 14,000 animals. The secretary is Charles Burgess, Wenona, Ill.

SUFFOLK.

The native home of the Suffolk breed is Suffolk County, in eastern England, and the production of the breed in that country is confined almost entirely to that and adjoining counties. The Suffolk has not been bred for the heavy draft work of the city, but largely for the farm, and for this purpose it ranks high among the farmers of eastern England, who consider it capable of doing a large amount of labor on a small amount of feed and for longer periods than other drafters. The breed is used more exclusively for farm work than any other of our draft breeds.

In size the Suffolk is smaller than other drafters; and while occasionally a mature stallion in fair condition may weigh 2,000 pounds, such a weight is not characteristic of the breed. Considering their

FIG. 10.—Suffolk stallion.

size, the Suffolks have a deep and wide body, and the ribs have a pronounced spring, giving the body a round and full appearance. The croup is straight, the sloping croup being seldom seen in this breed. The quarters are round and well muscled. The legs are short and are particularly free from long hair or feather, and the bone has the appearance of being small compared with the size of the body. The color is always chestnut, varying from light to dark. The Suffolk is active, has a good disposition, and is rated as an easy keeper.

The distinguishing characteristics of this breed may be said to be the invariable chestnut color, with little if any white; their smooth, rotund form; and the clean-boned leg, devoid of the feather characteristic of the other two British draft breeds.

The breed is criticized for the lack of size to supply the heavy-draft type demanded for the heavy hauling in the cities and for being too light in bone for the size of the body.

Suffolks were first imported into this country in the early eighties and have been imported since then in small numbers, but have never gained a very strong foothold here. One reason for this has no doubt been due to the lack of size as compared with other draft breeds. Another reason why no more have been imported has probably been that they have not been bred in very large numbers in England, being confined to a limited area, and the home demand by the farmers has been sufficient to take care of most of the animals produced; and, furthermore, other countries have purchased a good many at prices above what Americans would pay.

The Suffolks in this country are found in small numbers in a large number of States, but have never gained any strong foothold, and consequently their adaptability to our conditions can scarcely be judged. The stallions have been crossed to some extent on mares in this country, but the demand for extreme size has prevented such crossing from being carried on sufficiently to judge of its value, except in a small way.

The secretary of the American Suffolk Association is A. Graham Galbraith, De Kalb, Ill.

REFERENCE BOOKS ON BREEDS OF HORSES.

The Horse Book, by J. H. S. Johnstone, published by the Sanders' Publishing Co., Chicago, Ill.

Types and Breeds of Farm Animals, by Charles S. Plumb, published by Ginn & Co., New York, N. Y.

The Points of the Horse, by Capt. M. H. Hayes, published by Charles Scribner's Sons, New York, N. Y.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1914

U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 619

BREEDS OF DRAFT HORSES

THE PRODUCTION of high-class draft horses for breeding purposes has, since the termination of the World War, assumed special importance in the United States. Formerly it was customary for breeders to import annually many stallions and mares of the draft breeds from such countries as England, Scotland, Belgium, and France. Because the war greatly depleted the foreign supply, breeders in the United States are now dependent on draft horses raised in this country for their seed stock.

The purpose of this publication is to present in a concise manner the most important features regarding the breeds of draft horses in this country. No attempt has been made to give a history of the breeds or information regarding the early types, as such information would require considerable space and would be of little or no value to the general reader. The name and address of the secretary of the pedigree-record society for each breed are given at the conclusion of the portion dealing with that particular breed, and the reader is referred to the various societies for information regarding the rules of registry and the issuance of studbooks, or for lists of breeders.

Washington, D.C.

Issued November 1914
Revised September 1934

BREEDS OF DRAFT HORSES

By G. A. BELL, formerly *senior animal husbandman, Animal Husbandry Division, Bureau of Animal Industry*[1]

CONTENTS

POINTS OF THE DRAFT HORSE

THE draft type of horse is characterized by massiveness, and the particular field for this type is the hauling of heavy loads at a comparatively slow gait, usually at the walk. Therefore power and not speed is desired, and in order to possess this power the horse should be generally blocky or compact, low set or short legged, and be sufficiently heavy to enable him to throw the necessary weight into the collar to move the heavy load and at the same time maintain a secure footing.

The market requirements classify draft horses according to weight, quality, and utility into heavy draft, light draft, and loggers. The best heavy horses, classified as heavy drafters, stand from 16 to 17½ hands high (a " hand " being 4 inches) and weigh from 1,750 to 2,200 pounds. The light draft horses are similar in type to the heavy draft horses but are smaller. They range in height from 15¾ to 16½ hands and in weight from 1,600 to 1,750 pounds. The loggers are big, rugged horses suitable for lumbering work. Although as large and heavy as the heavy draft horses, they are plainer and sometimes slightly blemished or unsound. The range in height and weight for loggers is practically the same as for heavy drafters.

Chunks are classified chiefly from the standpoint of conformation. They are essentially little drafters, but are usually more blocky and compact. The eastern chunk is of true draft-horse conformation, but with less height and weight, ranging in height from 15 to 16 hands and in weight from 1,300 to 1,550 pounds. Farm chunks, commonly known as " general-purpose horses ", are not quite so heavy nor so good in quality as the eastern chunks. Farm chunks range in height from 15 to 15¾ hands and in weight from 1,200 to 1,400 pounds.

[1] Mr. Bell resigned from the Department Oct. 15, 1920. The bulletin has been revised by J. O. Williams and S. R. Speelman, Animal Husbandry Division.

In the typical drafter the head is comparatively lean, wide between the eyes, and in size proportionate to the body. The eye is bright and fairly prominent. The neck is strong and muscular, of fair length, and somewhat arched; in the stallion it is well arched or crested, in the gelding or mare less so. The shoulders are shorter and more upright than in the case of the light horse, and a happy medium between the straight and sloping shoulder gives the best combination of power and movement. Too straight a shoulder causes excessive concussion, and the result is bone and tendon trouble in

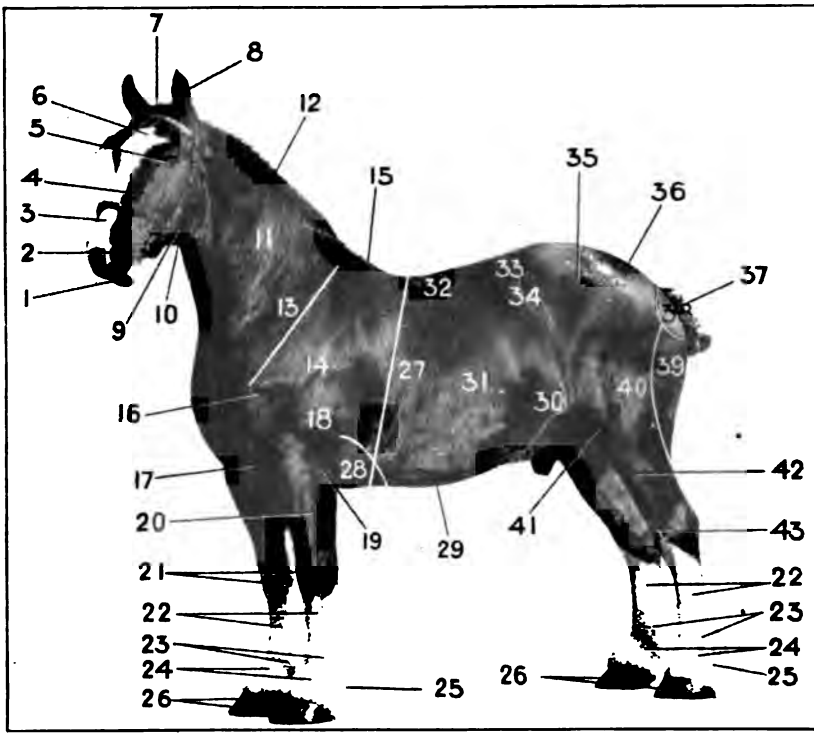

FIGURE 1.—The points of the horse: 1, Mouth; 2, nostril; 3, nose; 4, face; 5, eye; 6, forehead; 7, poll; 8, ear; 9, lower jaw; 10, throatlatch; 11, neck; 12, crest; 13, shoulder bed; 14, shoulder; 15, withers; 16, point of shoulder; 17, breast; 18, arm; 19, elbow; 20, forearm; 21, knees; 22, cannons; 23, fetlocks; 24, pasterns; 25, feather; 26, feet; 27, heart girth; 28, foreflank; 29, underline; 30, hind flank; 31, barrel; 32, back; 33, loin; 34, coupling; 35, hip; 36, croup; 37, tail; 38, buttock; 39, quarters; 40, thigh; 41, stifle; 42, gaskin; 43, hock.

the feet and legs. On the other hand, too sloping a shoulder renders it difficult to fit the heavy collars properly. In the draft horse, however, the former is much more common than the latter.

The chest is deep and comparatively broad, thus providing plenty of room for the lungs. The heart girth, or the body's circumference behind the forelegs, is large, and horses slack in that region are usually weak in constitution. The body is broad, deep, and comparatively short; the back is short and broad, and the ribs well sprung, giving a round appearance to the body. The horse with a shallow body is usually a poor feeder. The loin is broad and well muscled;

the croup is fairly level, long, broad, and well muscled. A short, decidedly sloping croup is not so well muscled as the straighter and longer one. The hind quarters and thighs are well muscled; it is from the hind quarters that the horse obtains most of its propelling power, the front legs acting largely as weight carriers.

Good underpinning, consisting of good legs and feet, is essential. Good, big, clean, heavy bone is necessary in order to afford attachments for the heavy muscles and to stand the wear and tear of hard work. The cannon bones are the best indication of the bone throughout. In this region the bone should feel firm, and the tendons should stand out distinctly from the bone, giving the cannon bones when viewed from the side a wide, flat appearance. The knee should be broad and deep when viewed from the front. The hock should be broad from front to back, and of strong structure. The pasterns should be fairly long and sloping. Though some draft horses possess too long and too sloping pasterns, a much larger number have too short and too straight pasterns. The foot should be fairly large and round and the horn dense. The dark-colored hoofs are most popular, as it is thought they denote greater durability. In the draft horse as much quality as is consistent with the required substance is desirable, but quality should not be obtained at the sacrifice of too much weight.

In temperament the draft horse is generally lymphatic, but he should not be too sluggish. Although the nature of his work requires him to be steady and easily managed, it is nevertheless essential that it should be performed willingly and with some snap and vigor.

The draft-horse gait is the walk. The stride should be rapid and of good length, and the feet should be carried straight forward. This kind of action makes possible the covering of the most ground in the least possible time. While the walk is the normal gait, the ability to trot well is desirable. Often faults not noticeable at the walk are brought out at the trot.

SCORE CARD FOR THE DRAFT HORSE[2]

SCALE OF POINTS

	Standard score
GENERAL APPEARANCE—18 points	
Height: Estimated hands -----; actual hands-----	
Weight: Estimated -----; actual -----; according to age and type----	4
Form: Broad, deep, massive, well proportioned, low set--------------	4
Quality and substance: Abundance of clean, flat bone; broad, well-defined joints and tendons; refined head and ears; fine skin and hair; feather, if present, silky------------------------------------	6
Temperament: Energetic, good disposition----------------------------	4
Head: Proportionate, medium size, clean cut; wide lower jaw--------	1
HEAD AND NECK—7 points	
Forehead: Broad, full--	1
Eyes: Large, prominent, bright, clear-------------------------------	1
Muzzle: Broad, fine; large nostrils; trim, even lips------------------	1
Ears: Of medium size, well set, carried alert--------------------------	1
Neck: Medium long, muscular; good crest; clean throatlatch----------	2

[2] Copies of this score card, known as A. H. form 295, may be procured on request from the Bureau of Animal Industry.

FOREHAND—26 points	Standard score
Shoulders: Sloping, muscular, blending into smooth withers	3
Arms: Short, muscular, elbow in	1
Forearms: Wide, muscular	2
Knees: Straight, wide, deep, well supported	2
Cannons: Short, wide, lean, flat; large, well-defined tendons	2
Fetlocks: Wide, straight, tendons well back, well supported	1
Pasterns: Of medium length, oblique (about 45°), clean, strong	3
Feet: Large, round, set straight; dense, smooth horn; slope of wall parallel to pastern, wide heels; concave sole; strong bars; prominent, elastic frog	8
Leg position: In front, a perpendicular line from point of shoulder should divide the leg and foot into lateral halves; from the side, a similar line from the bony prominence on shoulder blade should pass through the center of elbow, knee, and pastern joints, and meet the ground back of foot	4
BODY—9 points	
Chest: Deep, wide, large girth	2
Ribs: Long, well sprung, close, strongly coupled	2
Back: Short, broad, heavily muscled	2
Loin: Short, wide, heavily muscled	2
Flanks: Deep, full; long, low underline	1
HIND QUARTERS—30 points	
Hips: Wide, smooth, level, well muscled	2
Croup: Long, wide, muscular, not markedly drooping	2
Tail: Set high, well carried	1
Quarters and thighs: Deep, thick, muscular, strongly joined to gaskins	3
Stifles: Muscular, well set	1
Gaskins (lower thighs): Wide, heavily muscled	2
Hocks: Wide, deep, prominent point, clean cut, straight, well supported	6
Cannons: Similar to front except a trifle longer and wider	2
Fetlocks: Wide, straight, tendons well back, well supported	1
Pasterns: Similar to front but less sloping (about 50°)	2
Feet: Similar to front but not quite so large or so round	4
Leg position: From rear, a perpendicular line from point of buttock should divide the leg and foot into lateral halves; from the side, this same line should touch the point of hock and run parallel to the cannon. A similar line from the hip joint should meet the ground midway between the heel and toe	4
ACTION—10 points	
Walk: Straight, long stride, springy and balanced	6
Trot: Straight, long stride; free and regular	4
Total	100

BELGIAN

The Belgian draft horse (figs. 2 and 3), as the name indicates, originated and has been developed in Belgium, and is the only breed of horses which is bred to any extent in that country, the light horses used in Belgium being purchased largely in other countries. In 1886 the Belgian Draft Horse Society was organized for the purpose of encouraging the breeding of the native draft horse and to maintain a studbook for the breed. In June of each year the annual show of this society is held at Brussels. At the thirtieth annual show, held in June 1919, the entries totaled more than 800. In 1913 and 1914 the total number of entries for each year was in excess of 1,000. This event is probably the largest show of a single breed of horses ever held in the world. The breeding of Belgian draft horses is also promoted by the Government, which annually awards prizes and subsidies to the best animals in the various Provinces. Stallions which stand for public service must be approved by a commission appointed by the Government.

Importations of these horses into the United States were made more or less frequently during the last half of the nineteenth century, but it was not until the beginning of the twentieth century that they were imported in large numbers. The early trade was principally a stallion trade, but later quite large numbers of mares were imported.

The Belgian divides honors with the Shire as being the heaviest of the breeds. Mature stallions in fair condition, weighing a ton or more, are comparatively common. In height mature stallions will

FIGURE 2.—Belgian stallion.

probably average slightly over 16¼ hands, and mature mares about 16 hands. In general conformation they are the most compact of all breeds, the bodies being short, wide, and deep. The head is of medium size, the neck is short and heavily crested or arched, the chest is broad and deep, the back is short and well muscled over the loin, the croup is somewhat drooping or steep, and the quarters are full and heavily muscled. The legs are short and free from the long hair or feather characteristic of the Clydesdale and the Shire. In action the Belgian is good, but is less active than the Clydesdale or the Percheron. In temperament he is docile and easily handled. He is a good feeder, is rated as an easy keeper, and stands shipment well. The colors common to the Belgian are bay, chestnut, and roan, but browns, grays, and blacks are occasionally seen.

Some of the criticisms of the Belgium horse are that a large number have necks that are too short and heavy, too drooping a croup, a roughness about the hocks, bone that is not sufficiently flat, too short and straight in the pastern, hoof deficient in circumference, and a lack of general quality; but great improvement has been noted in respect to these deficiencies in recent years. The extreme width may cause the Belgians to roll somewhat at the walk, but as a class they are good movers at the trot.

In this country the Belgian sire has been valuable in improving the draft conformation of our horse stock, particularly when mated with many of our rangy, loosely coupled mares. The breed has made wonderful progress in this country, considering that it has attracted much attention only since the beginning of the twentieth century.

FIGURE 3.—Belgian mare.

In fact no breed of horses has shown a greater increase in popularity and a greater improvement during this period.

The distribution of the Belgian draft horse in the United States is widespread, but it is found in the greatest number in those sections where the heaviest type of draft horse is most prevalent, such as the Central West, particularly in Indiana, Iowa, Illinois, Ohio, Michigan, and Minnesota.

The American Association of Importers and Breeders of Belgian Draft Horses was organized in 1887, but the first volume of its studbook was not published until 1905. To date 14 volumes have been issued. Up to January 11, 1934, 18,455 stallions and 16,079 mares had been recorded. The secretary of the association is J. D. Conner, Jr., Wabash, Ind.

.PERCHERON

The Percheron (figs. 4 and 5) originated in France and has been developed in a small district in the northwestern part of that country known as Perche. This district is about one-fifteenth the size of the State of Iowa, and only Percherons born within its boundaries are eligible to registry in the Percheron Studbook of France. Percheron foals, to be accepted for registry in the French book, must be registered during the year of their birth. Prior to such registration they must be examined by an official appointed by the Percheron Horse Society of France, who takes a careful description of their color and markings and brands them on the neck with the letters "S.P." enlaced.

FIGURE 4.—Percheron stallion.

The Percheron Horse Society of France was organized in 1883, and in addition to looking after the registration of Percherons it holds an annual summer show in the Percheron district. The society also offers prizes at other shows. The improvement of the Percheron and other breeds in France is due to both public and private efforts. The Government has for a number of years maintained studs in which selected animals have been kept for breeding purposes. In addition, subsidies are granted to private individuals in order to keep high-class horses in the stud. Stallions intended to stand for public service in France must be examined by officials appointed by the Government and certified as being free from periodic ophthalmia, or moon blindness, and roaring (thick wind).

The introduction of Percheron horses into the United States dates back many years. One of the early stallions brought to this country which exerted considerable influence on our draft stock was Louis

Napoleon imported in 1851 by an Ohio firm. Other Percherons were imported about this time and during succeeding years. During the early seventies they were imported in large numbers, and these importations have continued to the present time.

The head of the Percheron is clean-cut, of medium size, and more refinement is noticed about the head and neck of the Percheron than in any other draft breed. The neck is rather short and well crested. The chest is deep and broad, the back is short, the loins smooth and well muscled. The croup is wide, and on the average is somewhat more sloping than is considered desirable, but great improvement in this respect has been made in recent years. The legs, feet, and bone are on the average good. The legs are free from the long hair

FIGURE 5.—American-bred Percheron mare.

or feather characteristic of the Clydesdale and the Shire. In action the Percheron is good at both the trot and the walk, and the trot is characterized by a snap and boldness not ordinarily displayed by most of the other draft breeds. This breed may be regarded as one of the best movers and is surpassed in style of action only by the Clydesdale.

The Percheron is not so large a horse as either the Belgian or the Shire, but as a class will probably outweigh the Clydesdale slightly. Good, mature stallions in fair condition will usually weigh from 1,800 to 2,000 pounds, and there are many which weigh considerably over 2,000 pounds. In height good, mature stallions will measure 16 to 17 hands, with a general average of about 16½ hands, but of course there are some under and a few over these heights, although the rangy, tall Percheron is not in demand in this country. The popular Percheron is rather short-legged, compact, and blocky in form, less so than the Belgian, but more so than the Clydesdale or even the Shire.

The colors common to the Percheron are black and gray, although bays, browns, chestnuts, and roans are occasionally seen. It may be safely stated, however, that 90 percent of our Percherons are either black or gray.

Occasionally difficulty may be experienced in deciding whether an animal is a Percheron or a Belgian, but the two types are very distinct. The Belgian is heavier bodied, more compact, shorter legged, and his head is more nearly square in outline; the neck is shorter, more heavily muscled, and more heavily crested. Moreover, the colors common to the Belgian—namely, bay, chestnut, and roan—are uncommon to the Percheron, whereas the gray and black colors common to the latter are uncommon in the Belgian.

Some Percherons are criticized as having croups too sloping or steep, with the tail set too low. Others are criticized as being too fine—not sufficiently drafty—having a lack of depth and fullness of body. Other faults which are sometimes seen are cannon bones which are rather round (lacking in breadth and flatness), lack of bone for the size of the body, and pasterns which are too short and straight.

The distribution of the Percheron in this country is very widespread, and for years it has been the favorite draft horse. In the United States today Percherons outnumber all other draft breeds combined, and there does not appear to be any diminution in their popularity. This probably is due in part to the good start given the breed by the pioneer importers and breeders, but this popularity must be attributed to some extent, at least, to their general adaptability to the needs and preférences of their owners. For crossing on ordinary mares the Percheron stallion has been very popular, so that grade Percherons are very common, and are great favorites in our horse markets.

In 1876 the National Association of Importers and Breeders of Percheron-Norman Horses was organized. The Percheron Society of America is an outgrowth of that association. The twenty-second volume of its studbook was issued in March 1926. No later volumes have been published. Up to January 16, 1934, 211,372 animals had been accepted for registration. The secretary of the society is Ellis McFarland, 828 Exchange Avenue, Union Stock Yards, Chicago, Ill.

FRENCH DRAFT

The name "French Draft" is the designation applied broadly to all breeds of draft horses originating in France, and does not refer to one specific breed as might be inferred from its usage in this country. This classification includes the Percheron and a number of other draft breeds in France, such as the Boulonnais, Nivernais, Breton, Ardennais, and Picardy. Of all the French breeds the Percheron is by far the best known, and has obtained a foothold in this country much greater than that of any other breed of draft horses.

Of the other French breeds, the Boulonnais and the Nivernais are the only ones of any particular interest in the United States.

The Boulonnais is found in northern France in the vicinity of Boulogne and adjoining districts in Belgium. This breed is probably a trifle larger than the Percheron and somewhat coarser, but in general type resembles the Percheron rather closely. The color common to the Boulonnais is gray, but occasionally other colors are seen. This breed has been imported in larger numbers than the Nivernais.

The home of the Nivernais is in central France, in the Department of Niève. In type it is very similar to the Percheron. The color is black.

The National French Draft Horse Association of America, which for many years fostered the interests of the French Draft breeds in this country, was organized in 1885 and succeeded the National Norman Horse Association, which had its beginning in 1876. Until its dissolution a short time ago, the National French Draft Horse Association published a studbook in which were registered horses of the French Draft breeds. Fourteen volumes of its studbook were published, and approximately 35,000 animals were registered.

CLYDESDALE

The Clydesdale (figs. 6 and 7) originated and has been developed in Scotland, and is practically the only draft horse found or favored in that country. The breed is of mixed origin, and its early history is more or less obscure.

In the formation of the breed and during the early stages of the breed's development, however, it is probable that the blood of both Flemish and English horses was used quite largely. For a number of years the Clydesdale has been bred pure. In 1878 the Clydesdale Horse Society of Great Britian and Ireland was organized.

The first Clydesdales brought to North America were probably imported into Canada by the Scotch who had settled there. In the early seventies Clydesdales were imported into this country both through Canada and by direct importation. By 1880 they were being imported in large numbers, and these importations continued for several years.

The Clydesdale is not so heavy as either the Belgian or the Shire, and probably, as a class, will not weigh quite so much as the Percheron. In general conformation, the Clydesdale is more rangy and lacks the width and compactness of the other breeds mentioned. The Scotch breeders have paid particular attention to legs, pasterns, and feet, but have placed less emphasis on weight than has been the case in other draft breeds. Average mature Clydesdale stallions in this country will probably weigh from 1,700 to 1,900 pounds when in fair condition, with an average height of nearly 16¾ hands. Mature mares will probably weigh 1,600 to 1,800 pounds and average about 16 hands in height.

No other draft breed equals the Clydesdale in style and action. The prompt walk with a good, long, snappy stride, and a sharp trot with hocks well flexed and carried close together are characteristic of this breed. Sound, clean, flat bone; well-set, fairly long, sloping pasterns; large, round feet; and a moderate amount of fine feather

FIGURE 6.—Clydesdale stallion.

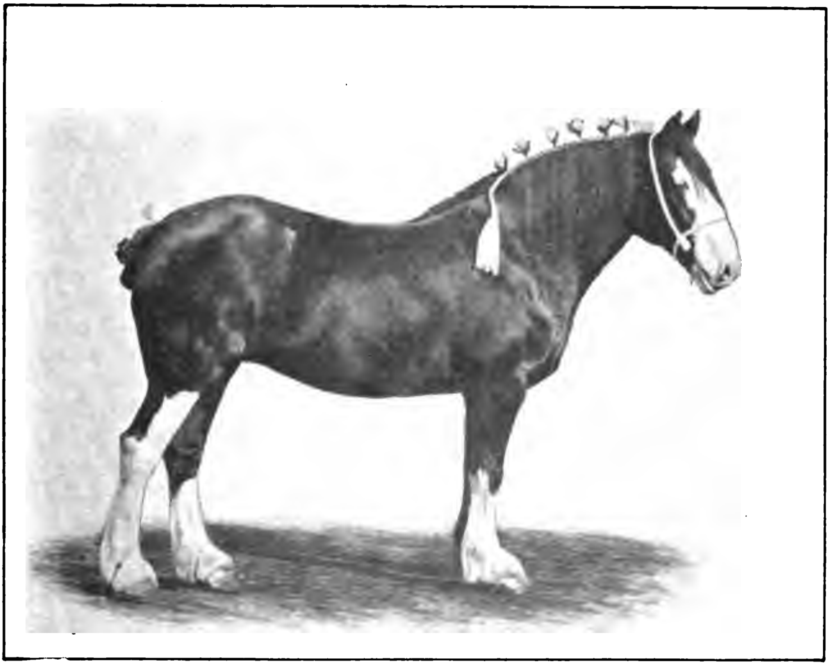

FIGURE 7.—Clydesdale mare.

or long hair at the rear of the legs below the knees and hocks are important and characteristic features. The colors most common are bay and brown with white markings, but blacks, grays, chestnuts, and roans are occasionally seen. The white markings are characteristic, and it is the exception to see a bay or brown Clydesdale without a white face and considerable white on the feet and legs.

Some of the criticisms of this breed have been the lack of size of body, lack of width and depth, too much feather, and too much white with no regularity of distribution. Most draft-horse users in this country, particularly farmers, dislike a horse with a white face and legs. Nor has the feather been very popular owing to the extra care necessary to keep the legs clean. This, of course, is not so objectionable in those sections where most or the roads are improved.

It is not always easy to differentiate between Clydesdales and Shires, but taking the breeds as a whole, they are very distinct. The Clydesdale is not so heavy bodied as the Shire, has more refinement, and the feather is somewhat more silky or finer and less abundant than in the Shire.

In this country Clydesdale geldings have been very popular in the cities for use by those who want draft horses with a good, long, snappy, ground-covering stride and at the same time possessing style and action. Our native mares of draft character bred to Clydesdale stallions have produced many excellent animals.

The distribution of the Clydesdale in this country is widespread throughout the northern half; the breed is seldom found, however, in the South. It has found the most favor in Iowa, Illinois, Wisconsin, Minnesota, North Dakota, and Indiana.

The American Clydesdale Association was organized in 1879, and up to February 1, 1934, had issued 21 volumes of the American Clydesdale Studbook. It is understood that three additional volumes are about ready for publication, and to February 23, 1934, 23,774 animals had been registered. The business of the society is handled by its secretary, Margaret Coridan, 842 Exchange Avenue, Union Stock Yards, Chicago, Ill.

SHIRE

The Shire (figs. 8 and 9) originated and was developed in England, and today is bred in all sections of that country. The real origin of this breed is more or less speculative. It is known that this type of draft horse existed in England in early times. It is probable that the early Shire was of very mixed breeding, but at the present time the Shire is bred very pure. In 1878 the Shire horse breeders of England were organized under the name of the English Cart Horse Society. In 1884 the name was changed to the Shire Horse Society. In addition to the registration of horses, the society holds an annual show and sale in London, and also awards medals and prizes at the leading agricultural shows in England and at some of the fairs and expositions in the United States.

Shires were imported into this country a good many years ago. George E. Brown, in volume 1 of the American Shire Horse Studbook, states that in 1853 a Mr. Strickland imported a stallion direct from England to Aurora, Ill., where the horse was known as John Bull. Volume 1 of this studbook shows the registration of a small

FIGURE 8.—Shire stallion.

FIGURE 9.—Shire mare.

number of stallions imported in 1880, and these importations increased until in 1887 more than 400 Shires were imported.

The Shire is a massive horse, with a wide, deep, and long body, and is equaled in weight only by the Belgian. Shire stallions in fair condition weighing 2,000 pounds or over are comparatively common. They are less compact, or more rangy, than the Belgian, and in height will average taller than any other draft breed. Stallions standing 17 hands or more in height are very common; in fact, the average height of mature Shire stallions in this country is close to 17 hands. Mature Shire mares will average about 16¼ hands in height and will, in fair condition, average about 1,800 pounds in weight. Heavy bone and feather are characteristic of this breed. In temperament the Shire is probably more lymphatic than any of our other breeds, and therefore less active than is desired by many. The common colors are bay and brown, with white markings, although blacks, grays, chestnuts, and roans are occasionally seen.

This breed has been criticized for lack of quality and refinement in general, a sluggish temperament, the abundance of feather, and the large amount of white, but breeders have shown marked progress in overcoming these objections during the last few years. From the standpoint of many users in the United States the abundant feather is objectionable, owing to the difficulty of keeping the legs clean.

Although some Shires and Clydesdales are so similar as to render it difficult at times to distinguish the one from the other, the two types are really very distinct. The Shire is more massive, heavier bodied throughout, and the feather or long hair on the legs is more abundant and coarser than that of the Clydesdale.

The distribution of the Shire throughout the northern half of this country is widespread, but like the Clydesdale, it is seldom found in the Southern States. This breed has met with the most favor in the Central West, particularly in Illinois, Iowa, and South Dakota; it is also popular on the Pacific coast in Washington and Oregon. A great many of our best market geldings possess some Shire blood; and where height as well as bone and substance is desired, it can be derived from Shire blood with greater certainty than from other breeds.

The American Shire Horse Association was organized in 1885 and has issued 11 volumes of its studbook. Up to January 10, 1934, 21,000 animals had been registered by the association. The secretary is J. G. Truman, Bushnell, Ill.

SUFFOLK

The native home of the Suffolk breed is Suffolk County, in eastern England, and the production of the breed in that country is confined almost entirely to that and adjoining counties. The Suffolk has not been bred for the heavy draft work of the city, but largely for the farm, and for this purpose it ranks high among the farmers of eastern England, who consider it capable of doing a large amount of labor on a small quantity of feed and for longer periods than other drafters. The breed is used more exclusively for farm than any other of the draft breeds.

In size the Suffolk (figs. 10 and 11) is smaller than other drafters; and though occasionally a mature stallion in fair condition may

FIGURE 10.—Suffolk stallion.

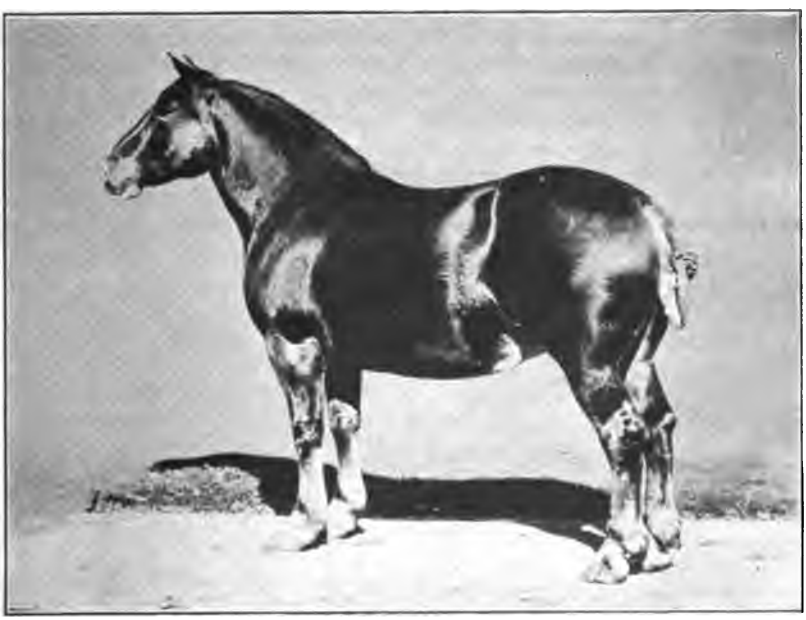

FIGURE 11.—Suffolk mare.

weigh 2,000 pounds, such a weight is not characteristic of the breed. Considering their size, the Suffolks have deep and wide bodies, and the ribs have a pronounced spring, giving the body a round and full appearance. The croup is straight, the sloping croup being seldom seen in this breed. The quarters are round and well muscled. The legs are short and are particularly free from long hair or feather, and the bone has the appearance of being small as compared with the size of the body. The color is always chestnut, varying from light to dark. The Suffolk is active, has a good disposition, and is rated as an easy keeper.

The distinguishing characteristics of this breed may be said to be the invariable chestnut color, with little if any white; their smooth rotund form; and the clean-boned leg, devoid of the feather characteristic of the other two British draft breeds.

The breed is criticized for the lack of size to supply the heavy draft type demanded for the heavy hauling in the cities and for being too light in bone for the size of the body.

Suffolks were first imported into this country in the early eighties and have been imported since then in small numbers, but have never gained a very strong foothold here. One reason for this has no doubt been the lack of size as compared with other draft breeds. Another reason that no more have been imported has probably been that they have not been bred in very large numbers in England, being confined to a limited area, and the home demand of the farmers has been sufficient to take care of most of the animals produced; furthermore, buyers in other countries have purchased a good many at prices above those Americans would pay.

The Suffolks in this country are found in small numbers in a number of States, but have never gained any strong foothold, and consequently their adaptability to our conditions can scarcely be judged. The stallions have been crossed to some extent on mares in this country, but the demand for extreme size has prevented such crossing from being carried on sufficiently to judge of its value, except in a small way.

The American Suffolk Horse Association has issued four volumes of the Suffolk Horse Studbook, and to February 21, 1934, 1,689 animals had been registered. The secretary is Veva Steffy, Bushnell, Ill.

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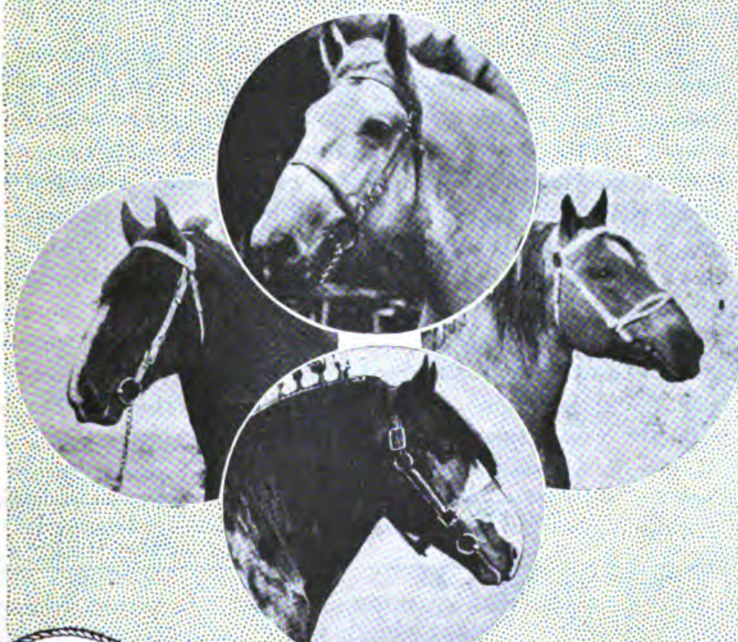
U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 619

BREEDS OF DRAFT HORSES



THE PRODUCTION of high-class draft horses for breeding purposes has, in recent years, assumed special importance in the United States. Formerly it was customary for breeders to import annually many stallions and mares of the draft breeds from such countries as England, Scotland, Belgium, and France. Because of the greatly depleted foreign supply, breeders in the United States are now dependent on draft horses raised in this country for their seed stock.

The purpose of this publication is to present in a concise manner the most important features of the breeds of draft horses in this country. No attempt has been made to give a history of the breeds or information about the early types, as such information would require considerable space and would be of little value to the general reader. For information regarding the rules of registry and the issuance of studbooks and for lists of breeders the reader is referred to the various associations.

Though encouraging the development of improved types of horses and other livestock, the Bureau has no jurisdiction over the registration of animals or the operation of the respective associations.

Washington, D. C.

Issued November 1914
Revised April 1941

BREEDS OF DRAFT HORSES

By Sanford R. Speelman, *associate animal husbandman, Animal Husbandry Division, Bureau of Animal Industry* [1]

Contents

POINTS OF THE DRAFT HORSE

THE draft type of horse (fig. 1) is characterized by massiveness, and the particular field for this type is the hauling of heavy loads at a comparatively slow gait, usually at the walk. Therefore power and not speed is desired, and in order to possess this power the horse should be generally blocky or compact, low-set or short-legged, and sufficiently heavy to enable him to throw the necessary weight into the collar to move the heavy load and at the same time maintain a secure footing.

The market requirements classify draft horses according to weight, quality, and utility into heavy draft, light draft, and loggers. The best heavy horses, classified as heavy drafters, stand from 16 to 17½ hands high (a "hand" being 4 inches) and weigh from 1,750 to 2,200 pounds. The light draft horses are similar in type to the heavy draft horses but are smaller. They range in height from 15¾ to 16½ hands and in weight from 1,600 to 1,750 pounds. The loggers are big, rugged horses suitable for lumbering work. Although as large and heavy as the heavy draft horses, they are plainer and sometimes slightly blemished or unsound. The range in height and weight for loggers is practically the same as for heavy drafters.

Chunks, essentially little drafters, are classified chiefly from the standpoint of conformation but are usually more blocky and compact. The eastern chunk is of true draft-horse conformation, but with less height and weight, ranging in height from 15 to 16 hands and in weight from 1,300 to 1,550 pounds. Farm chunks, commonly known as general-purpose horses, are not quite so heavy nor so good in quality as the eastern chunks. Farm chunks range in height from 15 to 15¾ hands and in weight from 1,200 to 1,400 pounds.

In the typical drafter the head is comparatively lean, wide between the eyes, and in size proportionate to the body. The eye is bright and fairly prominent. The neck is strong and muscular, of fair length, and somewhat arched; in the stallion it is well arched or crested, in the gelding or mare less so. The shoulders are shorter and more

[1] This is a revision of former editions by G. A. Bell, who resigned in 1920.

upright than those of the light horse, and a happy medium between the straight and sloping shoulder gives the best combination of power and movement. Too straight a shoulder causes excessive concussion, and the result is bone and tendon trouble in the feet and legs. On the other hand, too sloping a shoulder renders it difficult to fit the heavy collars properly. In the draft horse, however, the former is much more common than the latter.

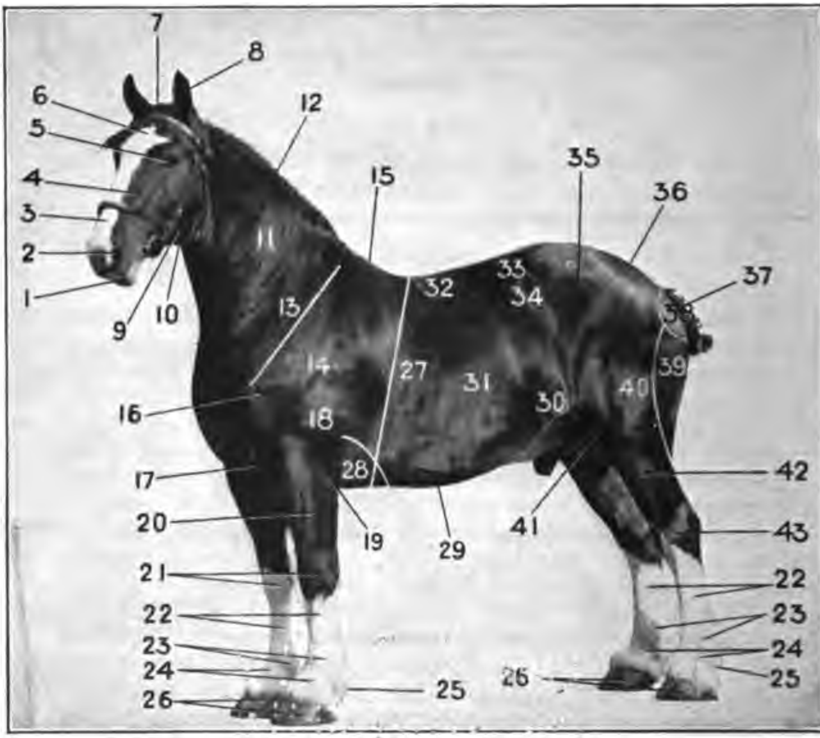


FIGURE 1.—The points of the horse: 1, Mouth; 2, nostril; 3, nose; 4, face; 5, eye; 6, forehead; 7, poll; 8, ear; 9, lower jaw; 10, throatlatch; 11, neck; 12, crest; 13, shoulder bed; 14, shoulder; 15, withers; 16, point of shoulder; 17, breast; 18, arm; 19, elbow; 20, forearm; 21, knees; 22, cannons; 23, fetlocks; 24, pasterns; 25, feather; 26, feet; 27, heart girth; 28, foreflank; 29, underline; 30, hind flank; 31, barrel; 32, back; 33, loin; 34, coupling; 35, hip; 36, croup; 37, tail; 38, buttock; 39, quarters; 40, thigh; 41, stifle, 42, gaskin; 43, hock.

The chest is deep and comparatively broad, thus providing plenty of room for the lungs. The heart girth, or the body's circumference behind the forelegs, is large, and horses slack in that region are usually weak in constitution. The body is broad, deep, and comparatively short; the back is short and broad and the ribs well sprung, giving a round appearance to the body. The horse with a shallow body is usually a poor feeder. The loin is broad and well muscled; the croup is fairly level, long, broad, and well muscled. A short, decidedly sloping croup is not so well muscled as the straighter and longer one. The hind quarters and thighs are well muscled; it is from the hind quarters that the horse obtains most of its propelling power, the front legs acting largely as weight carriers.

SCORE CARD FOR THE DRAFT HORSE[2]

SCALE OF POINTS

	Standard score
GENERAL APPEARANCE—18 points	
Height: Estimated hands ------; actual hands ------	
Weight: Estimated ------; actual ------; according to age and type	4
Form: Broad, deep, massive, well proportioned, low set	4
Quality and substance: Abundance of clean, flat bone; broad, well-defined joints and tendons; refined head and ears; fine skin and hair; feather, if present, silky	6
Temperament: Energetic, good disposition	4
HEAD AND NECK—7 points	
Head: Proportionate, medium size, clean cut; wide lower jaw	1
Forehead: Broad, full	1
Eyes: Large, prominent, bright, clear	1
Muzzle: Broad, fine; large nostrils; trim, even lips	1
Ears: Of medium size, well-set, carried alert	1
Neck: Medium long, muscular; good crest; clean throatlatch	2
FOREHAND—26 points	
Shoulders: Sloping, muscular, blending into smooth withers	3
Arms: Short, muscular, elbow in	1
Forearms: Wide, muscular	2
Knees: Straight, wide, deep, well supported	2
Cannons: Short, wide, lean, flat; large, well-defined tendons	2
Fetlocks: Wide, straight, tendons well back, well supported	1
Pasterns: Of medium length, oblique (about 45°), clean, strong	3
Feet: Large, round, set straight; dense, smooth horn; slope of wall parallel to pastern; wide heels; concave sole; strong bars; prominent, elastic frog	8
Leg position: In front, a perpendicular line from point of shoulder should divide the leg and foot into lateral halves; from the side, a similar line from the bony prominence on shoulder blade should pass through the center of elbow, knee, and pastern joints, and meet the ground back of foot	4
BODY—9 points	
Chest: Deep, wide, large girth	2
Ribs: Long, well sprung, close, strongly coupled	2
Back: Short, broad, heavily muscled	2
Loin: Short, wide, heavily muscled	2
Flanks: Deep, full; long, low underline	1
HIND QUARTERS—30 points	
Hips: Wide, smooth, level, well muscled	2
Croup: Long, wide, muscular, not markedly drooping	2
Tail: Set high, well carried	1
Quarters and thighs: Deep, thick, muscular, strongly joined to gaskins	3
Stifles: Muscular, well set	1
Gaskins (lower thighs): Wide, heavily muscled	2
Hocks: Wide, deep, prominent point, clean cut, straight, well supported	6
Cannons: Similar to front except a trifle longer and wider	2
Fetlocks: Wide, straight, tendons well back, well supported	1
Pasterns: Similar to front but less sloping (about 50°)	2
Feet: Similar to front but not quite so large or so round	4
Leg position: From rear, a perpendicular line from point of buttock should divide the leg and foot into lateral halves; from the side, this same line should touch the point of hock and run parallel to the cannon. A similar line from the hip joint should meet the ground midway between the heel and toe	4
ACTION—10 points	
Walk: Straight, long stride, springy and balanced	6
Trot: Straight, long stride; free and regular	4
Total	100

[2] Copies of this score card, known as A. H. Form 295, may be procured on request from the Bureau of Animal Industry.

Good underpinning, consisting of good legs and feet, is essential. Good, big, clean, heavy bone is necessary in order to afford attachments for the heavy muscles and to stand the wear and tear of hard work. The cannon bones are the best indication of the bone throughout. In this region the bone should feel firm, and the tendons should stand out distinctly from the bone, giving the cannon bones when viewed from the side a wide, flat appearance. The knee should be broad and deep when viewed from the front. The hock should be broad from front to back, and of strong structure. The pasterns should be fairly long and sloping. Though some draft horses possess too long and too sloping pasterns, a much larger number have too short and too straight pasterns. The foot should be fairly large and round and the horn dense. The dark-colored hoofs are most popular, as it is thought they denote greater durability. In the draft horse as much quality as is consistent with the required substance is desirable, but quality should not be obtained at the sacrifice of too much weight.

In temperament the draft horse is generally lymphatic, but he should not be too sluggish. Although the nature of his work requires him to be steady and easily managed, it is nevertheless essential that he perform it willingly and with some snap and vigor.

The draft-horse gait is the walk. The stride should be rapid and of good length, and the feet should be carried straight forward. This kind of action makes possible the covering of the most ground in the least possible time. While the walk is the normal gait, the ability to trot well is desirable. Often faults not noticeable at the walk are brought out at the trot.

BELGIAN

The Belgian draft horse (figs. 2 and 3), as the name indicates, originated and has been developed in Belgium, and is the only breed of horses which is bred to any extent in that country, the light horses used in Belgium being purchased largely in other countries. In 1886 the Belgian Draft Horse Society was organized for the purpose of encouraging the breeding of native draft horses and of maintaining a studbook for the breed. In June of each year the annual show of this society is held at Brussels. At the thirtieth annual show, held in June 1919, the entries totaled more than 800. In 1913 and 1914 the total number of entries for each year was in excess of 1,000. This event is probably the largest show of a single breed of horses ever held in the world. The breeding of Belgian draft horses is also promoted by the Government, which annually awards prizes and subsidies to the best animals in the various Provinces. Stallions which stand for public service must be approved by a commission appointed by the Government.

Importations of these horses into the United States were made more or less frequently during the last half of the nineteenth century, but it was not until the beginning of the twentieth century that they were imported in large numbers. The early trade was principally a stallion trade, but later a considerable number of mares were imported.

The Belgian divides honors with the Shire as being the heaviest of the breeds. Mature stallions in fair condition, weighing a ton or more, are comparatively common. In height mature stallions will probably average slightly over 16¼ hands, and mature mares about 16 hands. In general conformation they are the most compact of all breeds, the bodies being short, wide, and deep. The head is of medium size, the neck is short and heavily crested or arched, the chest is broad and deep, the back is short and well muscled over the loin, the croup is somewhat drooping or steep, and the quarters are full and heavily muscled. The legs are short and free from the long hair or feather characteristic of the Clydesdale and the Shire. In action the Belgian is good, but is less active than the Clydesdale or the Percheron. In temperament he is docile and easily handled. He is a

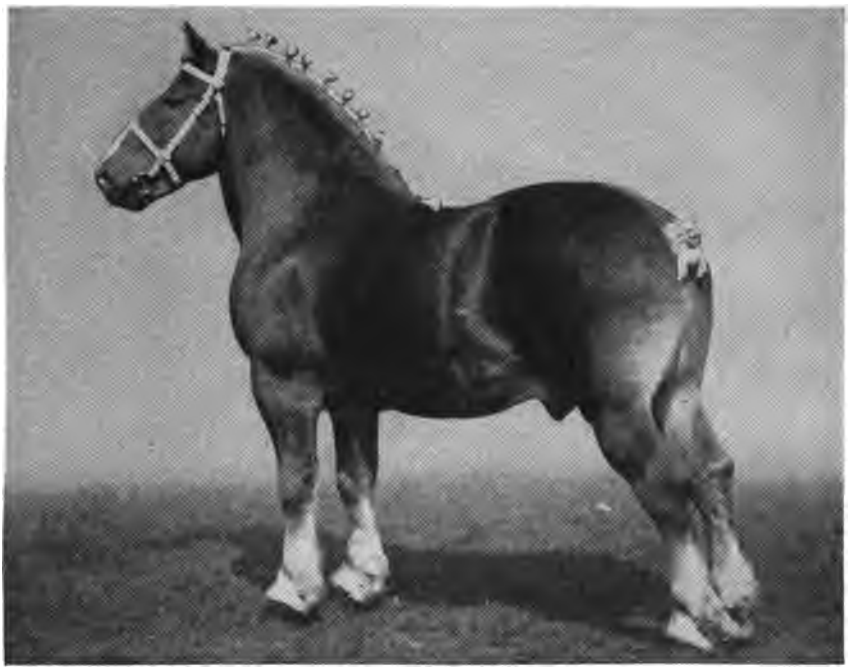


FIGURE 2.—Belgian stallion.

good feeder, is rated as an easy keeper, and stands shipment well. The colors common to the Belgian are bay, chestnut, and roan, but browns, grays, and blacks are occasionally seen.

Some of the criticisms of the Belgian horse are that a large number have necks that are too short and heavy, too drooping a croup, a roughness about the hocks, bone that is not sufficiently flat, too short and straight a pastern, hoof deficient in circumference, and a lack of general quality; but great improvement has been noted in respect to these deficiencies in recent years. The extreme width may cause Belgians to roll somewhat at the walk, but as a class they are good movers at the trot.

In this country the Belgian sire has been valuable in improving the draft conformation of our horse stock, particularly when mated with many of our rangy, loosely coupled mares. The breed has made wonderful progress in this country, considering that it has attracted much attention only since the beginning of the twentieth century.

In fact no breed of horses has shown a greater increase in popularity and a greater improvement during this period.

The distribution of the Belgian draft horse in the United States is widespread, but it is found in the greatest numbers in those sections where the heaviest type of draft horse is most prevalent, such as the Central West, particularly in Indiana, Iowa, Illinois, Ohio, Michigan, and Minnesota.

The American Association of Importers and Breeders of Belgian Draft Horses was organized in 1887, but the first volume of its studbook was not published until 1905. Twenty-three volumes have

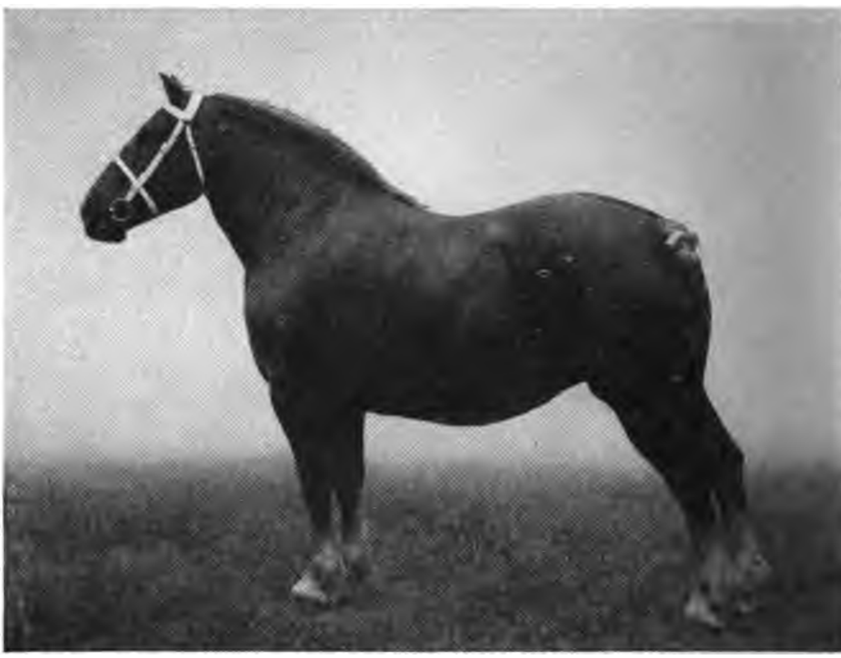


FIGURE 3.—Belgian mare.

been issued, and up to December 31, 1939, 25,378 stallions and 25,476 mares had been recorded. The secretary of the association, which is now known as the Belgian Draft Horse Corporation of America, is H. J. Brant, 161 Ferry Street, Wabash, Ind.

PERCHERON

The Percheron (figs. 4 and 5) originated in France and has been developed in a small district in the northwestern part of that country known as Perche. This district is about one-fifteenth the size of the State of Iowa, and only Percherons born within its boundaries are eligible to registry in the Percheron Studbook of France. Percheron foals, to be accepted for registry in the French book, must be registered during the year of their birth. Prior to such registration they must be examined by an official appointed by the Percheron Horse Society of France, who takes a careful description of their color and markings and brands them on the neck with the letters "S. P." enlaced.

The Percheron Horse Society of France was organized in 1883, and in addition to looking after the registration of Percherons it holds an annual summer show in the Percheron district. The society also offers prizes at other shows. The improvement of the Percheron and other breeds in France is due to both public and private efforts. The Government has for a number of years maintained studs in which selected animals have been kept for breeding purposes. In addition, subsidies are granted to private individuals in order to keep high-class horses in the stud. Stallions intended to stand for public service in France must be examined by officials appointed by the Government

FIGURE 4.—Percheron stallion.

and certified as being free from periodic ophthalmia, or moon blindness, and roaring (thick wind).

The introduction of Percheron horses into the United States dates back many years. One of the early stallions brought to this country which exerted considerable influence on our draft stock was Louis Napoleon imported in 1851 by an Ohio firm. Other Percherons were imported about this time and during succeeding years. During the early seventies they were imported in large numbers, and these importations have continued to the present time.

The head of the Percheron is clean-cut, of medium size, and more refinement is noticed about the head and neck of the Percheron than in any other draft breed. The neck is rather short and well crested. The chest is deep and broad, the back is short, the loins smooth and well muscled. The croup is wide, and on the average is somewhat more sloping than is considered desirable, but great improvement in this respect has been made in recent years. The legs, feet, and bone are on the average good. The legs are free from the long hair or feather characteristic of the Clydesdale and the Shire. In action the Percheron is good at both the trot and the walk, and the trot is characterized by a snap and boldness not ordinarily displayed by most of the other draft breeds. This breed may be regarded as one of the best movers and is surpassed in style of action only by the Clydesdale.

The Percheron is not so large a horse as either the Belgian or the Shire, but as a class will probably outweigh the Clydesdale slightly. Good, mature stallions in fair condition will usually weigh from 1,800

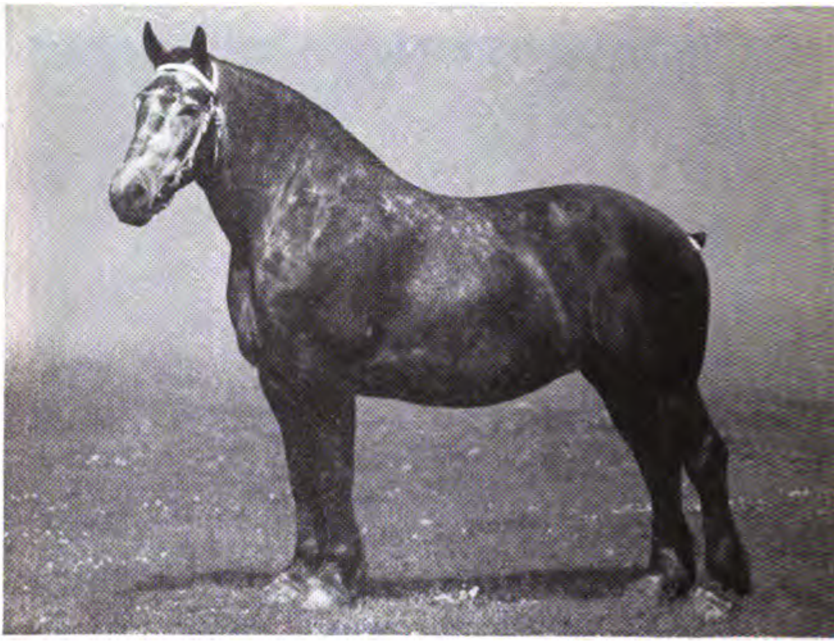


FIGURE 5.—Percheron mare.

to 2,000 pounds, and there are many which weigh considerably over 2,000 pounds. In height good mature stallions will measure 16 to 17 hands, generally averaging about 16½ hands, but of course there are some under and a few over these heights, although the rangy, tall Percheron is not in demand in this country. The popular Percheron is rather short-legged, compact, and blocky in form, less so than the Belgian, but more so than the Clydesdale or even the Shire.

The colors common to the Percheron are black and gray, although bays, browns, chestnuts, and roans are occasionally seen. It may be safely stated, however, that 90 percent of our Percherons are either black or gray.

Occasionally difficulty may be experienced in deciding whether an animal is a Percheron or a Belgian, but the two types are very distinct. The Belgian is heavier bodied, more compact, shorter legged, and his head is more nearly square in outline; the neck is shorter, more heavily muscled, and more heavily crested. Moreover, the colors common to the Belgian—namely, bay, chestnut, and roan—are uncommon to the Percheron, whereas the gray and black colors common to the latter are uncommon in the Belgian.

Some Percherons are criticized as having croups too sloping or steep, with the tail set too low. Others are criticized as being too fine—not sufficiently drafty—having a lack of depth and fullness of body. Other faults which are sometimes seen are cannon bones which are rather round (lacking in breadth and flatness), lack of bone for the size of the body, and pasterns which are too short and straight.

The distribution of the Percheron in this country is very widespread, and for years it has been the favorite draft horse. In the United States today Percherons outnumber all other draft breeds combined, and there does not appear to be any diminution in their popularity. This probably is due in part to the good start given the breed by the pioneer importers and breeders, but this popularity must be attributed to some extent, at least, to their general adaptability to the needs and preferences of their owners. For crossing on ordinary mares the Percheron stallion has been very popular, so that grade Percherons are very common and are great favorites in our horse markets.

In 1876 the National Association of Importers and Breeders of Percheron-Norman Horses was organized. The Percheron Society of America, now known as the Percheron Horse Association of America, was an outgrowth of that association. The twenty-third volume of its studbook was issued in July 1936. No later volumes have been published. Up to December 31, 1939, 236,069 animals had been accepted for registration. The secretary is Ellis McFarland, 9 Dexter Park Avenue, Union Stock Yards, Chicago, Ill.

FRENCH DRAFT

The name "French Draft" is applied broadly to all breeds of draft horses originating in France and does not refer to one specific breed, as might be inferred from its usage in this country. This classification includes the Percheron and a number of other draft breeds in France, such as the Boulonnais, Nivernais, Breton, Ardennais, and Picardy. Of all the French breeds the Percheron is by far the best known and has obtained a much greater foothold in this country than any other breed of draft horses. Of the other French breeds, the Boulonnais and the Nivernais are the only ones of any particular interest in the United States.

The Boulonnais is found in northern France in the vicinity of Boulogne and in adjoining districts in Belgium. This breed is probably a trifle larger than the Percheron and somewhat coarser but in general type resembles the Percheron rather closely. The color common to the Boulonnais is gray, but occasionally other colors are seen. This breed has been imported in larger numbers than the Nivernais.

The home of the Nivernais is in central France, in the Department of Niève. In type it is very similar to the Percheron. The color is black.

The National French Draft Horse Association of America, which for many years fostered the interests of the French Draft breeds in this country, was organized in 1885 and succeeded the National Norman Horse Association, which had its beginning in 1876. Until its dissolution the National French Draft Horse Association published a studbook in which were registered horses of the French Draft breeds. Fourteen volumes of its studbook were published, and approximately 35,000 animals were registered.

CLYDESDALE

The Clydesdale (figs. 6 and 7) originated and has been developed in Scotland, and is practically the only draft horse found or favored in that country. The breed is of mixed origin, and its early history is more or less obscure.

FIGURE 6.—Clydesdale stallion.

In the formation of the breed and during the early stages of the breed's development, however, it is probable that the blood of both Flemish and English horses was used quite largely. For a number of years the Clydesdale has been bred pure. In 1878 the Clydesdale Horse Society of Great Britain and Ireland was organized.

The first Clydesdales brought to North America were probably imported into Canada by the Scotch who had settled there. In the early seventies Clydesdales were imported into this country both through Canada and by direct importation. By 1880 they were being imported in large numbers, and these importations continued for several years.

The Clydesdale is not so heavy as either the Belgian or the Shire, and probably, as a class, will not weigh quite so much as the Percheron. In general conformation, the Clydesdale is more rangy and lacks the width and compactness of the other breeds mentioned.

The Scotch breeders have paid particular attention to legs, pasterns, and feet, but have placed less emphasis on weight than has been the case in other draft breeds. Average mature Clydesdale stallions in this country will probably weigh from 1,700 to 1,900 pounds when in fair condition, with an average height of nearly 16¾ hands. Mature mares will probably weigh 1,600 to 1,800 pounds and average about 16 hands in height.

No other draft breed equals the Clydesdale in style and action. The prompt walk with a good, long, snappy stride, and a sharp trot with hocks well flexed and carried close together are characteristic

FIGURE 7.—Clydesdale mare.

of this breed. Sound, clean, flat bone; well-set, fairly long, sloping pasterns; large, round feet; and a moderate amount of fine feather or long hair at the rear of the legs below the knees and hocks are important and characteristic features. The colors most common are bay and brown with white markings, but blacks, grays, chestnuts, and roans are occasionally seen. The white markings are characteristic, and it is the exception to see a bay or brown Clydesdale without a white face and considerable white on the feet and legs.

Some of the criticisms of this breed have been the lack of size of body, lack of width and depth, too much feather, and too much white with no regularity of distribution. Most draft-horse users in this country, particularly farmers, dislike a horse with a white face and legs. Nor has the feather been very popular owing to the extra care necessary to keep the legs clean. This, of course, is not so objectionable in those sections where most of the roads are improved.

It is not always easy to differentiate between Clydesdales and Shires, but taking the breeds as a whole, they are very distinct. The Clydesdale is not so heavy bodied as the Shire, has more refinement, and the feather is somewhat more silky or finer and less abundant than in the Shire.

In this country Clydesdale geldings have been very popular in the cities for use by those who want draft horses with a good, long, snappy, ground-covering stride and at the same time possessing style and action. Our native mares of draft character bred to Clydesdale stallions have produced many excellent animals.

The distribution of the Clydesdale in this country is widespread throughout the northern half; the breed is seldom found, however, in the South. It has found the most favor in Iowa, Illinois, Wisconsin, Minnesota, North Dakota, and Indiana.

The American Clydesdale Association was organized in 1879 and operated under that name until 1934, when it became known as the Clydesdale Breeders Association of the United States. Up to December 31, 1939, these associations had issued 21 volumes of the American Clydesdale Studbook. It is understood that three additional volumes are about ready for publication, and to December 31, 1939, 24,784 animals had been registered. The business of the society is handled by its secretary, Margaret Coridan, 840 Exchange Avenue, Union Stock Yards, Chicago, Ill.

SHIRE

The Shire (figs. 8 and 9) originated and was developed in England and today is bred in all sections of that country. The real origin of this breed is more or less speculative. It is known that this type of draft horse existed in England in early times. It is probable that the early Shire was of very mixed breeding, but at the present time the Shire is bred very pure. In 1878 the Shire horse breeders of England were organized under the name of the English Cart Horse Society. In 1884 the name was changed to the Shire Horse Society. In addition to the registration of horses, the society holds an annual show and sale in London, and also awards medals and prizes at the leading agricultural shows in England and at some of the fairs and expositions in the United States.

Shires were imported into this country a good many years ago. George E. Brown, in volume 1 of the American Shire Horse Studbook, states that in 1853 a Mr. Strickland imported a stallion direct from England to Aurora, Ill., where the horse was known as John Bull. Volume 1 of this studbook shows the registration of a small number of stallions imported in 1880, and these importations increased until in 1887 more than 400 Shires were imported.

The Shire is a massive horse, with a wide, deep, and long body, and is equaled in weight only by the Belgian. Shire stallions in fair condition weighing 2,000 pounds or over are comparatively common. They are less compact, or more rangy, than the Belgian, and in height will average taller than any other draft breed. Stallions standing 17 hands or more in height are very common; in fact, the average height of mature Shire stallions in this country is close to 17 hands. Mature Shire mares will average about 16¼ hands in height and will, in fair condition, average about 1,800 pounds in weight. Heavy bone and feather are characteristic of this breed. In temperament the Shire is probably more lymphatic than any of our other breeds, and therefore less active than is desired by many. The common colors are bay and brown, with white markings, although blacks, grays, chestnuts, and roans are occasionally seen.

This breed has been criticized for lack of quality and refinement in general, a sluggish temperament, the abundance of feather, and the large amount of white, but breeders have shown marked progress in

FIGURE 8.—Shire stallion.

overcoming these objections during the last few years. From the standpoint of many users in the United States the abundant feather is objectionable, owing to the difficulty of keeping the legs clean.

Although some Shires and Clydesdales are so similar as to render it difficult at times to distinguish the one from the other, the two types are really very distinct. The Shire is more massive, heavier bodied, throughout, and the feather or long hair on the legs is more abundant and coarser than that of the Clydesdale.

The distribution of the Shire throughout the northern half of this country is widespread, but like the Clydesdale, it is seldom found in the Southern States. This breed has met with the most favor in the Central West, particularly in Illinois, Iowa, and South Dakota; it is also popular on the Pacific coast. A great many of our best market geldings possess some Shire blood; and where height as well as bone and substance is desired, it can be derived from Shire blood with greater certainty than from other breeds.

The American Shire Horse Association was organized in 1885 and has issued 14 volumes of its studbook. Up to December 31, 1939, 21,712 animals had been registered by the association. The secretary is E. F. Fox, 319 East Fourth Street, Des Moines, Iowa.

SUFFOLK

The native home of the Suffolk breed is Suffolk County, in eastern England, and the production of the breed in that country is confined

FIGURE 9.—Shire mare.

almost entirely to Suffolk and adjoining counties. Some authorities believe the Suffolk originated about A. D. 1700 and that possibly it is a descendant of Normandy horse stock. However, the breed's foundation is usually traced back to a prolific chestnut-colored stallion, known as the Crisp Horse, who was foaled in Sussex in 1768 and is credited with being the progenitor of all stock registered in the English and American studbooks for Suffolk horses. Throughout its relatively long history the Suffolk has been bred pure, and as a consequence the type has generally been kept quite uniform. Moreover, the Suffolk has not been bred for the heavy draft work of the city but largely for the farm, and for this purpose it ranks high among the farmers of eastern England, who consider it capable of doing a large amount of labor on a small quantity of feed and for longer periods than other drafters. The breed is used more exclusively for farm work than are any other of the draft breeds.

In size the Suffolk (figs. 10 and 11) is smaller than other drafters; and though occasionally a mature stallion in fair condition may weigh 2,000 pounds, such a weight is not characteristic of the breed. Considering their size, the Suffolks have deep and wide bodies, and the ribs have a pronounced spring, giving the body a round and full appearance. The croup is straight, the sloping croup being seldom seen in this breed. The quarters are round and well muscled. The legs are short and are particularly free from long hair or feather, and the bone has the appearance of being small as compared with the size of the body. The color is always chestnut, varying from light to

FIGURE 10.—Suffolk stallion.

dark. The Suffolk is active, has a good disposition, and is rated as an easy keeper.

The distinguishing characteristics of this breed may be said to be the invariable chestnut color, with little if any white; their smooth rotund form; and the clean-boned leg, devoid of the feather characteristic of the other two British draft breeds.

In former years Suffolks were criticized by some Americans for their lack of scale and for being too light in bone for the size of the body. Of these faults the lack of body size is generally not so important a factor now owing to present-day tendencies to produce somewhat lighter and handier horses for farm work purposes. Also it is the opinion of some Suffolk owners that, on account of general cleanness of leg, the smallness of bone is probably more apparent than real.

Suffolks were first imported into this country in the early eighties and have been imported since then in small numbers, possibly because of lack of size as compared with other draft breeds. Another reason that no more have been imported has probably been that they have not been bred in very large numbers in England, being confined to a limited area, and the home demand of the farmers has been sufficient to take care of most of the animals produced; furthermore, buyers in other countries have purchased a good many at prices above those Americans would pay.

The Suffolks in this country are found in small numbers in a number of States, but have never gained any strong foothold, and consequently their adaptability to our conditions can scarcely be judged.

FIGURE 11.—Suffolk mare.

The stallions have been crossed to some extent on mares in this country, but the demand for extreme size has prevented such crossing from being carried on sufficiently to judge of its value, except in a small way.

The American Suffolk Horse Association has issued five volumes of the Suffolk Horse Studbook, and to December 31, 1939, 2,120 animals had been registered. The secretary is J. G. Truman, Bushnell, Ill.

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U.S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN
620
Contribution from the Bureau of Crop Estimates, Leon M. Estabrook, Chief.
September 16, 1914.

THE AGRICULTURAL OUTLOOK.

CONTENTS.

TIME OF ISSUANCE AND SCOPE OF OCTOBER CROP REPORTS.

A report showing the condition of the cotton crop on September 25 will be issued by the Bureau of Crop Estimates of the Department of Agriculture on Friday, October 2, at 12 noon (eastern time), the date announced for the Census Bureau's report of cotton ginned. An act of Congress requires that the condition reports of the cotton crop shall be issued on the same day in October each year as the first ginners' report of actual cotton ginned. This will be the last regular cotton condition report of the season. The estimate of total production will be made in December.

On Wednesday, October 7, at 2.15 p. m. (eastern time), there will be issued a crop summary, as follows: Condition, either on October 1 or at time of harvest, of corn, buckwheat, potatoes, tobacco, flaxseed, apples, rice; yield per acre, total production (preliminary estimate), and quality of spring wheat, oats, and barley.

A supplemental report will be issued, giving a general review of the crop situation as of October 1, which will include the following crops: Condition, either on October 1 or at time of harvest, of clover seed, sweet potatoes, grapes, pears, cranberries, oranges, lemons, sugar cane, sorghum, sugar beets, peanuts; production, compared with a full crop (by percentages), of alfalfa seed, millet, kafir corn, tomatoes, cabbages, onions, beans, hemp, broom corn; average yield per acre and quality of hops.

GENERAL REVIEW OF CROP CONDITIONS, SEPTEMBER 1, 1914.

The month of August was generally favorable for crops in the Southern States and unfavorable in the Northern States. Important losses are shown in corn and spring wheat, and wonderful improvement shown in cotton. The net result is a slight decline, the composite condition of all crops September 1 being 2.1 per cent below the 10-year September 1 average, whereas the August 1 condition was 2 per cent below the August 1 10-year average. Prospects are for crop yields averaging 4.9 per cent better than last year, which was a poor crop year.

The Crop Reporting Board of the Bureau of Crop Estimates makes the following estimates from reports of its correspondents and agents:

TABLE 1.—*Estimated condition and acreage of specified crops: Total for the United States.*

Crop.	Condition in percentage of normal.				Acreage, 1914.	
	Sept. 1, 1914.	Sept. 1, 1913.	Sept. 1, 10-y. av.	Aug. 1, 1914.	Per cent of 1913.	Acres.
Winter wheat	....	....	....	....	111.6	35,387,000
Spring wheat	[1] 68.0	[1] 75.3	[1] 76.6	75.5	97.3	17,990,000
All wheat	....	....	....	....	106.4	53,377,000
Corn	71.7	65.1	79.4	74.8	99.3	105,067,000
Oats	[1] 75.8	[1] 74.0	[1] 79.1	79.4	100.0	38,383,000
Barley	[1] 82.4	[1] 73.4	[1] 80.2	85.3	100.4	7,528,000
Rye	....	....	....	....	99.1	2,533,000
Buckwheat	87.1	75.4	85.4	88.8	98.9	796,000
White potatoes	75.8	69.9	78.0	79.0	101.1	3,708,000
Sweet potatoes	81.8	81.4	86.2	75.5	94.9	598,000
Tobacco	71.4	74.5	80.6	66.5	94.6	1,151,000
Flax	72.9	74.9	80.4	82.1	84.1	1,927,000
Rice	88.9	88.0	88.7	87.6	85.2	704,800
Hay (tame)	....	....	....	86.7	98.9	48,400,000
Cotton	[2] 78.0	[2] 68.2	[2] 73.4	[2] 76.4	96.7	36,960,000
Apples	61.9	47.7	53.6	61.3	....	....

[1] Condition at time of harvest. [2] Condition 25th of preceding month.

TABLE 2.—*Estimated yields indicated by the condition of specified crops on Sept. 1, 1914, final yields in preceding years, for comparison, and farm price Sept. 1, 1914: Total for the United States.*

Crop.	Yield per acre.		Total production (in millions of bushels).				Farm price Sept. 1.		
			1914 [1]						
	1914 [1]	1900–1913 average.	September forecast.	August forecast.	1913, final.	1909–1913 average, final.	1914	1913	1909–1913 average.
	Bush.	*Bush.*					*Cents.*	*Cents.*	*Cents.*
Winter wheat	[2] 19.1	15.6	[2] 675	[2] 675	523	441	....	....	....
Spring wheat	12.2	13.3	221	236	240	245	....	....	....
All wheat	16.8	14.7	896	911	763	686	93.3	77.1	87.7
Corn	24.9	25.9	2,598	2,634	2,447	2,708	81.5	75.4	71.2
Oats	29.1	30.6	1,116	1,153	1,122	1,131	42.3	39.3	39.1
Barley	26.3	24.3	200	203	178	182	52.5	55.2	59.5
Rye	[2] 16.8	16.1	[2] 42	[2] 43	41	35	75.4	63.0	71.4
Buckwheat	21.5	20.5	17	17	14	17	78.8	70.0	74.0
White potatoes	98.0	97.1	371	370	332	357	74.9	75.3	79.7
Sweet potatoes	93.0	92.7	55	56	59	58	92.7	....	....
Tobacco ....lbs.	729.0	815.1	862	794	954	996	....	....	....
Flax	8.0	7.8	15	17	18	20	139.3	127.8	167.4
Rice	34.5	33.3	24	24	26	24	....	....	....
Hay (tame) ...tons.	[2] 1.42	1.34	[2] 69	69	64	66	$11.91	$11.80	$12.04
Apples ....bush.	....	....	220	230	145	178	[3] 68.6	[3] 75.2	[3] 72.4

[1] Interpreted from condition reports. [2] Preliminary estimate. [3] Average Aug. 15.

TABLE 3.—*Growing condition of specified crops Sept. 1, expressed in percentages of their 10-year average (not the normal) on Sept. 1, and the improvement (+) or decline (—) during August: Total for the United States.*

Crop.	Condition in percentage of 10-year average, Sept. 1.	Change during August.	Crop.	Condition in percentage of 10-year average, Sept. 1.	Change during August.	Crop.	Condition in percentage of 10-year average, Sept. 1.	Change during August.
Peaches [1]	116.0	....	Millet	103.4	+2.6	Sorghum	97.0	+ 5.6
Apples	115.5	+ 2.2	Sugar beets	103.0	−0.4	Lima beans	96.9	+ 6.0
Cranberries	115.3	....	Barley	102.7	−1.2	Clover seed	96.5	....
Cantaloupes [1]	108.1	....	Buckwheat	102.0	+2.3	Sweet potatoes	96.0	+ 8.7
Grapes	107.8	+ 3.1	Oranges	101.5	−0.7	Oats	95.8	− 2.3
Kafir corn	107.2	+ 3.4	Peanuts	101.4	+4.3	Sugar cane	91.8	+ 6.5
Cotton	106.3	+10.8	Beans (dry)	101.1	−0.7	Flax	90.7	− 8.7
Hay	106.0	....	Rice	100.2	+1.1	Corn	90.3	− 1.0
Watermelons [1]	105.8	....	Tomatoes	97.5	+4.0	Spring wheat	88.8	− 5.5
Lemons	105.6	+ 0.2	Potatoes	97.2	+2.1	Tobacco	88.6	+ 7.0
Alfalfa [1]	105.2	....	Cabbages	97.1	+1.9	Hemp	88.5	+ 6.3
Pears	105.0	+ 5.3	Onions	97.0	+3.6	Hops	88.5	−11.5
Broomcorn	104.1	+ 4.1						

[1] Production compared with full crop.

TABLE 4.—*Combined condition of all crops (100 = average), and change during August, by States.*

State.	Combined condition (per cent).	Change.	State.	Combined condition (per cent).	Change.	State.	Combined condition (per cent).	Change.
Maine	108.8	− 0.3	Ohio	96.2	+ 0.1	Texas	104.8	+15.5
New Hampshire	108.0	− 5.9	Indiana	86.3	− 0.6	Oklahoma	102.3	+ 9.0
Vermont	96.8	− 1.6	Illinois	81.6	− 2.3	Arkansas	92.5	+ 9.0
Massachusetts	111.2	+ 4.9	Michigan	108.1	− 1.2	Montana	91.5	− 4.6
Rhode Island	106.0	+10.2	Wisconsin	101.8	− 5.5	Wyoming	99.5	+ 0.6
Connecticut	108.8	+ 5.3	Minnesota	91.0	− 3.4	Colorado	106.5	− 5.7
New York	103.7	+ 0.3	Iowa	97.3	− 7.4	New Mexico	111.3	− 1.7
New Jersey	106.7	+ 2.6	Missouri	80.8	− 8.2	Arizona	97.7	− 3.3
Pennsylvania	103.2	− 1.7	North Dakota	98.9	− 8.5	Utah	98.7	− 6.5
Delaware	105.7	+ 0.5	South Dakota	95.4	+ 1.4	Nevada	118.9	+14.1
Maryland	110.2	− 1.6	Nebraska	99.7	− 5.9	Idaho	95.0	− 5.1
Virginia	85.6	− 7.1	Kansas	118.7	− 4.2	Washington	102.4	− 0.8
West Virginia	86.4	+ 1.3	Kentucky	90.4	+11.1	Oregon	94.2	− 6.4
North Carolina	101.1	+ 1.5	Tennessee	94.3	+10.2	California	108.5	+ 0.1
South Carolina	99.9	+ 3.2	Alabama	98.3	+ 4.0			
Georgia	103.3	+ 5.1	Mississippi	98.9	+ 3.2	United States	97.9	− 0.1
Florida	100.0	+ 1.7	Louisiana	96.2	+ 3.9			

COTTON CONDITION AUGUST 25, 1914, WITH COMPARISON.

The Crop Reporting Board of the Bureau of Crop Estimates estimates, from the reports of the correspondents and agents, that the condition of the cotton crop on August 25 was 78 per cent of a normal, as compared with 76.4 on July 25, 1914, 68.2 on August 25, 1913, 74.8 on August 25, 1912, and 73.4, the average on August 25 of the past 10 years.

TABLE 5.—*Condition of the cotton crop and farm price, by States.*

State.	Aug. 25, 1914.	July 25, 1914.	Aug. 25. 1913	Aug. 25. 1912	Aug. 25. 10-year average.	Farm price. Sept. 1, 1914.	Farm price. Aug. 1, 1914.	Farm price. Sept. 1— 1913	Farm price. Sept. 1— 1912
Virginia	86	89	80	80	81	9.6	12.2	12.6	11.1
North Carolina	82	86	78	75	77	9.6	12.5	11.8	11.5
South Carolina	77	79	77	73	76	8.7	12.9	11.7	11.7
Georgia	81	82	76	70	76	7.9	12.9	11.7	11.4
Florida	83	86	81	73	78	13.0	17.0	14.0	14.0
Alabama	77	81	72	75	74	8.5	12.8	11.6	11.1
Mississippi	75	79	69	70	73	9.1	12.5	12.0	11.5
Louisiana	66	76	67	74	68	10.0	12.2	11.8	11.0
Texas	79	71	64	76	70	8.3	12.0	11.9	11.1
Arkansas	75	72	72	77	76	10.0	11.7	11.7	11.2
Tennessee	76	73	80	76	82	10.1	12.5	11.8	11.1
Missouri	72	75	72	78	83	8.0	12.1	11.5	9.2
Oklahoma	80	75	45	84	73	8.8	12.0	11.7	11.5
California	98	100	96	95	......	......	......	......	......
United States	78.0	76.4	68.2	74.8	73.4	8.7	12.4	11.8	11.3

TABLE 6.—*Condition of the cotton crop monthly and the estimated yield per acre for the past 10 years.*

TOTAL FOR THE UNITED STATES.

Year.	May 25.	June 25.	July 25.	Aug. 25.	Sept. 25.	Yield per acre.
						Lbs. lint.
1913	79.1	81.8	79.6	68.2	64.1	182.0
1912	78.9	80.4	76.5	74.8	69.6	190.9
1911	87.8	88.2	89.1	73.2	71.1	207.7
1910	82.0	80.7	75.5	72.1	65.9	170.7
1909	81.1	74.6	71.9	63.7	58.5	154.3
1908	79.7	81.2	83.0	76.1	69.7	194.9
1907	70.5	72.0	75.0	72.7	67.7	178.3
1906	84.6	83.3	82.9	77.3	71.6	202.5
1905	77.2	77.0	74.9	72.1	71.2	186.1
1904	83.0	88.0	91.6	84.1	75.8	204.9
Average, 1904–13	80.4	80.7	80.0	73.4	68.5	187.2

TREND OF PRICES OF FARM PRODUCTS.

The level of prices paid producers of the United States for the principal crops decreased about 2.7 per cent during August; in the past 6 years the price level has decreased during August 2.4 per cent.

On September 1 the index figure of crop prices was about 3.7 per cent higher than a year ago, 2.7 per cent higher than 2 years ago, and 3.9 per cent higher than the average of the past 6 years on September 1.

The level of prices paid to producers of the United States for meat animals increased 3.0 per cent during the month from July 15 to August 15. This compares with an average advance from July 15 to August 15 in the past four years of 0.8 per cent.

On August 15 the average (weighted) price of meat animals—hogs, cattle, sheep, and chickens—was $7.63 per 100 pounds, which compares with $7.20 a year ago, $6.56 two years ago, $5.87 three years ago, and $6.67 four years ago on August 15.

A tabulation of prices is shown on pages 32 and 33.

SUGAR-BEET PROSPECTS.

The condition of sugar beets September 1 was 92.5 per cent of a normal. This forecasts a yield per acre of about 10.4 tons. The actual outturn will likely be above or below this amount according as conditions at harvest are better or worse than usual. A yield of 10.4 tons on the estimated planted acreage, 520,600 acres, amounts to 5,414,000 tons, or 52,000 tons more than were indicated by the condition of the growing beets on August 1. But there is usually some abandonment of acreage, the average in recent years being 10 per cent. Assuming an average abandonment of 10 per cent, there would result about 4,873,000 tons of sugar beets. The production in 1913 was 5,659,000 tons, which produced 1,466,802,000 pounds of sugar.

FLORIDA AND CALIFORNIA CROP REPORT.

TABLE 7.—*Crop conditions in Florida and California.*

Crop.	Florida.				California.			
	Condition Sept. 1—			Condition Aug. 1, 1914.	Condition Sept. 1—			Condition Aug. 1, 1914.
	1914	1913	1912		1914	1913	1912	
Oranges	87	89	97	87	89	76	87	88
Lemons					92	61	89	91
Limes	85	100	95	88				
Grapefruit	87	84	94	88				
Peaches, production [1]	75	45	79		94	65	85	
Peaches, quality	80	68	80		95	89	92	
Pears					84	73	85	84
Watermelons [1]	74	79	80		95	82	86	
Cantaloupes [1]	68	73	68		97	86	89	
Apricots					80	65	83	77
Prunes					74	70	89	73
Olives					87	78	80	85
Almonds					84	55	83	83
Walnuts					84	77	86	82
Velvet beans	88	92		86				
Grapes:								
For wine					89	80	87	93
For raisins					90	75	85	91
For table					91	80	87	93

[1] Production compared with a full crop.

HONEY PRODUCTION.

The results of the first inquiry of the Bureau of Crop Estimates on honey production are presented in Table 8. The figures given are based upon estimates received from the bureau's regular corps of correspondents and from a large special list of bee keepers. The number and character of the reports received insure that the figures given fairly reflect the relative yield per colony this year and last, with the one exception that the fall flow this autumn may increase somewhat the yields for 1914. The returns were particularly full and adequate from all of the important honey-producing sections.

The yield is based on the total honey surplus (removed or to be removed from the hive) divided by the number of colonies remaining at the close of last winter.

The honey yield in the white-clover belt of the central northern States has been very disappointing, especially when compared with the abundant yield last year and also with the unusually bright prospects early in the present year. Through many portions of this belt the crop failed entirely. The yields in the more northern States, where the dependence upon white clover is not so great, were fair, though generally somewhat under those of last year.

The yields in the important honey-producing regions of southern California and southern Texas were good. The alfalfa yield in Colorado and Utah was fair, though not equal to last year. The South Atlantic and east Gulf States have yields about the same as last year—near an average crop.

An interesting fact, developed by this inquiry, is that the proportion of comb and "chunk" honey is decreasing and that the extracted is increasing. Testimony from the producers of bee keepers' supplies is corroborative of this finding.

The practical failure of honey production in much of the white-clover belt should put bee keepers there on the alert to supplement the bees' scanty fall stores with sirup to prevent winter loss from starvation, unless the fall flow should prove unexpectedly abundant. Though the cost of sugar is high, a good colony of bees is worth much more than the cost of furnishing full stores for the winter.

A special report from Porto Rico shows continued large increases in the number of colonies of bees in that island, which fact is reflected in the phenomenal increase in export of honey and beeswax, the value of which has increased from about $5,000 to $100,000 during the past six years. A good strong colony in Porto Rico is expected to produce about 300 pounds of honey a year, the nectar flow, largely from flowering trees, being practically continuous throughout the year.

TABLE 8.—*Honey— Yield per colony and proportion of crop in comb, extract, and chunk, 1914, with comparisons.*

State.	Yield per colony.		Form of honey produced.					
			Proportions in 1914.			Proportions in 1909.		
	1914	1913	Comb.	Extract.	Chunk.	Comb.	Extract.	Chunk.
	Lbs.	*Lbs.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Maine	45	38	80	15	5	80	20	0
New Hampshire	27	27	......	......	......	......	......	......
Vermont	39	33	65.9	28.1	6	70	28.8	1.2
Massachusetts	25	31	66.9	32.4	0.7	86	12	2
Rhode Island	40	45	5	95	0	10	90	0
Connecticut	28	35	48	47	5	58	33	9
New York	20	37	47	50	3	60	38	2
New Jersey	10	40	25	75	0	65	35	0
Pennsylvania	35	45	65	29	6	74	21	5
Delaware	15	21	......	......	......	......	......	......
Maryland	30	40	69	22	9	90	10	0
Virginia	30	38	87	12	1	93	7	0
West Virginia	26	20	57	38	5	......	......	......
North Carolina	35	25	45	30	25	43	21	36
South Carolina	25	25	......	......	......	......	......	......
Georgia	30	30	28	33	39	54	15	31
Florida	42	50	11	88	1	15	84	1
Ohio	17	50	66	32	2	68	29	3
Indiana	14	60	52	36	12	62	25	13
Illinois	12	60	42	56	2	53	46	1
Michigan	37	50	56	43	1	69	30	1
Wisconsin	45	60	41	58	1	28	71	1
Minnesota	35	60	36	63	1	52	48	0
Iowa	20	65	56	42	2	65	34	1
Missouri	5	30	32	38	30	41	35	24
North Dakota	......	......	......	......	......	......	......	......
South Dakota	20	50	77	22	1	65	30	5
Nebraska	30	50	43	42	15	61	38	1
Kansas	25	25	67	28	5	78	19	3
Kentucky	8	40	49	33	18	50	27	23
Tennessee	30	30	31	23	46	26	19	55
Alabama	32	35	34	41	25	39	32	29
Mississippi	31	35	49	26	25	43	27	30
Louisiana	40	35	0	100	0	......	......	......
Texas	55	35	4	51	45	1	40	59
Oklahoma	25	35	36	17	47	40	15	45
Arkansas	15	30	25	15	60	15	5	80
Montana	30	35	......	......	......	......	......	......
Wyoming	75	75	92	8	0	5	95	0
Colorado	40	60	67	30	3	70	28	2
New Mexico	85	50	31	61	8	37	61	2
Arizona	63	70	6	94	0	10	90	0
Utah	65	70	17	83	0	0	100	0
Nevada	50	75	......	......	......	......	......	......
Idaho	50	55	47	51	2	67	30	3
Washington	55	45	46	54	0	59	41	0
Oregon	45	40	64	34	2	58	38	4
California	75	36	18	79	3	20	79	1
United States	31.6	40.6	41.7	42.1	16.2	46.5	34.9	18.6

The receipts of butter and eggs at five primary markets, as reported to the Bureau of Crop Estimates, for August, 1914, were: Butter, 12,613,611 pounds; eggs, 319,873 cases. The average receipts for August during the five years 1910–1914 were: Butter, 13,569,915 pounds; eggs, 299,375 cases.

CONFERENCE ON THE COTTON MARKETING SITUATION.

By CHARLES J. BRAND, *Chief, Office of Markets.*

The proper marketing of the cotton crop, an unsolved problem even in times of peace, has been made infinitely more difficult and almost impossible by the war in Europe. The gravity of the situation, due to the interruption of the export business, not only to the cotton industry, but also to the whole business structure of the country, led Secretary of the Treasury McAdoo to call a conference to advise with him as to remedial measures that might be taken. About 150 persons, representative of all of the interests in the cotton trade, were in attendance at the meetings at the Pan American Building on August 24 and 25, 1914.

Recently in normal years about two-thirds of the crop has gone abroad. The value of this export has amounted to from $500,000,000 to $600,000,000 per year. Last year it approximated the latter figure, about 8,700,000 bales of our 14,000,000-bale crop going into foreign commerce, while roughly 5,300,000 bales were used at home. Of the quantity exported something less than 7,000,000 bales went to the countries now in a state of war. England, with takings of about 3,500,000 bales, is, of course our greatest customer. Germany directly imports considerably less than half that quantity and ranks second.

The problem so far as the United States is concerned is further complicated by the Indian and other crops, totaling between 7,000,000 and 8,000,000 bales, many of which are without their usual market, thus necessarily adding to the pressure on the price of an international crop like cotton.

The disturbed and panicky spirit that appeared to some extent during the first day of the conference disappeared on the second. This change has been reflected in the country at large, not so much because of the things specifically accomplished by the meeting, as on account of the clearing away of a multitude of rather impractical and imprudent expedients that had been suggested and championed by various individuals and interests as remedies. It is rather characteristic of American business to lay to and do things as soon as it is clear what can be done under a given set of conditions.

Many estimates have been made as to the surplus of our crop that must be taken care of until better conditions prevail. The general opinion of the representatives of the producing, banking, manufacturing, and other interests at the conference indicated that a volume of from 4,000,000 to 5,000,000 bales would have to be provided for in some way.

It is estimated that of the 143,000,000 spindles in the world, 50,000,000 are in countries that are at peace; 32,000,000 of these are in the United States and 18,000,000 in other countries. As there are 6,000,000 spindles in India working almost wholly on coarse goods, and over 2,000,000 in Japan, there remain only 10,000,000 outside of these three countries.

Some American mills are closing down, others are working only part time, or with reduced force. They are buying naturally rather on a hand-to-mouth basis. Spinners, except in the distinctly standard lines, feel that they must have orders in hand to justify manufacture. The problem then from the standpoint of any help the mills can give is to get orders. No effort should be spared in this direction. The Department of Commerce is helping so far as lies within its authority in opening up new foreign markets, but private initiative must not wait for too much government help in such a situation.

If the quantity to be carried over until next year is to be reduced to a minimum, American mills must increase their production to at least full capacity of present spindles. Japan, with a total spindleage only about 200,000 greater than that of Georgia, is reported as working overtime. In the interruption of the movement of goods in the regular channels of trade, in common with all neutrals, the United States has suffered seriously and manufacturers and sales agencies have not yet been able to open up new markets. Furthermore, many cases are reported in which orders even from other countries on the American continent have been canceled. The closely intermingled commercial relations that exist are well shown by the fact that the cancellation of European orders for copper from Bolivia have brought about the cancellation of orders for cotton goods from certain American mills, resulting in at least one case in a complete shutdown.

A considerable part of the discussion during the conference had for its object the obtaining for State banks which are not under the control of the Comptroller of the Currency of the same privileges as are accorded to National banks. The Secretary of the Treasury made it perfectly clear that there is no legislation under which such action could be taken, even if it were considered desirable. However, it was pointed out that State banks would not be without relief on this account as they are largely customers of National banks which would be in a position to accept their paper.

So far as warehousing facilities are concerned, the discussion at the conference developed the general lack of adequate facilities for protecting the cotton crop. Certain of the States, notably Georgia, are rather well supplied, but there naturally exists no organization through whose instrumentality there can be brought about the complete utilization of the warehouses that we have. The opinion appeared to prevail among many in attendance at the conference that the passage of the warehouse legislation pending in Congress might assist somewhat in a more efficient utilization of present space.

There is a general absence of public bonded warehouses throughout the cotton belt because of the unusual number of defalcations and malfeasances that have occurred in the cotton-warehouse business.

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Bonding companies have been loath to extend their surety in the cotton trade. Warehousing operations will be promoted to the greatest extent in those States whose laws afford most adequate protection for the surety companies. The prevention of fraud in the matter of warehouse receipts is more important than the question of the character of the warehouse itself. As pointed out in the conference, it is not necessary that cotton be stored in bonded, brick, frame, or corrugated-iron warehouses. A floor which will keep the cotton off the ground, a covering which will keep off the rain, and a fence and a guard that will prevent theft are all that are absolutely necessary in the way of buildings, though they do not represent the most desirable degree of protection. But protection against the fraudulent use of warehouse receipts is absolutely essential.

The conference itself to some extent and subsequent smaller conferences have developed the difficulties that are bound to arise in connection with the insuring of the large quantity of cotton which may be held over. The proper protection of say $200,000,000 worth of cotton presents some difficult problems in insurance, especially in connection with warehousing. In normal times 60 per cent of the crop goes abroad and is covered by marine insurance from the time it is delivered to the carrier at interior points until it arrives at its foreign destination. This year it seems likely that only a small percentage of such protection will be in effect at any one time. The hazards are not only those of construction, location, safeguarding of warehouses, and the like, but there has always been in times past a largely increased moral hazard which arises especially when the price that may be obtained for cotton falls below the insurance upon it.

It may be said that both the bonding and insurance interests have expressed a desire and willingness to lend all possible assistance compatible with good business policy.

The holding over of a large portion of this year's product constitutes a grave danger to future crops, which was seriously discussed by some of the speakers at the conference. It was assumed that there would be a very large reduction in acreage next year unless a cessation of hostilities brought about a speedy return to normal conditions. It is difficult to estimate the value of the factors on which such an assumption is based, and it seems that there should be definite work in all of the cotton States having in mind positive action toward increasing the production of food and forage crops and reducing cotton acreage correspondingly.

A subject scarcely touched upon at the conference is the acute situation that prevails in the cotton-seed trade. Interior points at which prices of from $18 to $24 per ton prevailed at this time last year are quoted at the present time anywhere from $4 to $12 below last year's prices.

The fertilizer interests of the country, which have a very acute interest in the marketing of the cotton crop on account of the fact that they advance from $60,000,000 to $75,000,000 worth of fertilizer a year to help make the crop, were represented at the conference. Their general position necessarily favored action looking toward at least reasonable recognition by the Treasury Department of commercial paper based on cotton.

In addition to Secretary McAdoo, Secretary Houston, Postmaster General Burleson, and the whole membership of the Federal Reserve Board were present at the conference. Certain of Secretary McAdoo's statements in connection with the matter are of such importance they are quoted herewith:

Among the eligible securities to be used as a basis for the issue of currency, I have decided to accept from National banks, through their respective National Currency Associations, notes, secured by warehouse receipts, for cotton or tobacco, and having not more than four months to run, at 75 per cent of their face value. The banks and the assets of all banks belonging to the currency association will be jointly and severally liable to the United States for the redemption of such additional circulation and a lien will extend to and cover the assets of all banks belonging to the association and to the securities deposited by the banks with the association, pursuant to the provisions of law, but each bank composing such association will be liable only in proportion that its capital and surplus bear to the aggregate capital and surplus of all such banks.

This plan ought to enable the farmers to pick and market the cotton crop if the bankers, merchants, and cotton manufacturers will cooperate with each other and with the farmers, and will avail of the relief offered by the Treasury within reasonable limits. Such cooperation is earnestly urged upon all these interests. The farmer can not expect as high a price for cotton this year because of the European war, yet he should not be forced to sacrifice his crop. The banker and the merchant should not exact excessive rates of interest, and the manufacturers should replenish their stocks as much as possible and pay reasonable prices for the product. If this is done, and it can be done if every one displays a helpful spirit, a normal condition can be restored and there ought to be no serious difficulty in taking care of the cotton problem.

This is a time when the entire country expects that purely selfish interests shall be subordinated to the common good; that undue advantage shall not be taken of the necessities of each other. I am happy to say that this spirit seemed to animate those who attended the so-called cotton conference held at my request in Washington on August 24 and 25.

Since the law leaves it entirely in the discretion of the Secretary of the Treasury to issue or not to issue the currency to which I have referred, I shall not hesitate to refuse it if I am convinced that it will be used merely for speculative purposes instead of for the operation of harvesting and carrying the crop until a reasonable market can be found and for the needs of legitimate business.

It is not my purpose to prescribe the character of warehouses in which cotton and tobacco may be stored. The banks will be relied upon to see that warehouse receipts issued by responsible warehousemen or warehouse companies alone are accepted, and that the cotton and tobacco stored in such warehouses is covered by adequate fire insurance and is protected against injury by the elements.

In order to obtain such currency the following things should be observed by banks applying therefor:

1. Not less than 10 National banks in any given territory, each having an unimpaired capital and surplus of not less than 20 per cent, desiring such currency shall form a National currency association, with an aggregate capital and surplus of not

less than $5,000,000, as required by the act. Full particulars and blank forms for this purpose may be had upon application to the Comptroller of the Currency, Washington, D. C.

2. Any National currency association formed in accordance with law will receive the approval of the Secretary of the Treasury. Already 37 such associations have been organized in the various States.

3. Under the law the Secretary of the Treasury may accept as security for currency—

(a) Bonds of any State or of any city, town, county, or other legally constituted municipality or district in the United States which has been in existence for a period of 10 years and which, for a period of 10 years previous to such deposit as security, has not defaulted in the payment of any part of either principal or interest of any funded debt authorized to be contracted by it, and whose net funded indebtedness does not exceed 10 per cent of the valuation of its taxable property, to be ascertained by the last preceding valuation of property for the assessment of taxes.

(b) Any securities, including commercial paper, approved by the Secretary of the Treasury, held by a national bank and made available through a National currency association under the direction and control of the Secretary of the Treasury, at not exceeding 75 per cent of the cash value of such securities or commercial paper.

(c) No National bank shall be permitted to issue circulating notes based on commercial paper alone in excess of 30 per cent of its unimpaired capital and surplus.

4. The total amount of currency issuable to any bank, including its circulating notes issued against United States bonds, shall not be more than 125 per cent of its unimpaired capital and surplus.

5. Each bank or currency association receiving currency must maintain in the Treasury at Washington a redemption fund in gold of at least 5 per cent. The Secretary of the Treasury may, at any time, require such additional deposits in gold as, in his judgment, may be sufficient for the redemption of such notes.

By reason of a unanimous vote of the conference Secretary McAdoo appointed a committee to formulate a report and suggestions to him with regard to the matters considered at the conference. A few of the more important features of the committee's report were as follows:

That it is the sense of the committee that cotton, tobacco, and naval stores should be marketed as deliberately as possible until they can again be exported in normal quantity and that when properly conditioned should be warehoused with responsible concerns, that they should be protected against weather damage, and be properly insured against loss or damage by fire.

That warehouse receipts for these commodities are proper collateral for loans by banks, and should be so accepted, with such limitations as to margin, inspection, and valuation as conservative bankers may each in their discretion see fit to impose.

That the average market value of middling cotton for the past six years has been in excess of 12 cents per pound, that the committee is informed that the cost of producing cotton averages throughout the United States about 9½ cents a pound, that it is a rule of economics that the production of staple commodities will decrease if they continue unsalable at less than the cost of production plus a reasonable profit. That cotton does not deteriorate when properly warehoused, and is as good 20 years after it is picked as when it is first gathered; that it can therefore be carried over until the restoration of normal business conditions enables the world's consumption to absorb it. The committee is therefore of the opinion that every effort should be made to assist the producers to hold their cotton for a price that will minimize their loss as far as possible until such time as the channels of foreign trade shall be reopened. That loans upon cotton made upon a basis of 8 cents per pound for middling, less such margin as the lender shall consider necessary, will afford reasonable protection to bankers and will greatly facilitate the financing of our most important export crop in the present emergency.

That in suggesting 8 cents per pound for middling cotton as a basis for loans, it is not the purpose of the committee to convey the idea that that figure represents in their opinion the intrinsic value of cotton, but that it is sufficient in their judgment to meet the requirements of the situation, and enable the farmer to market his cotton in an orderly and deliberate manner.

That in the case of tobacco and naval stores the committee is informed that when these commodities are properly conditioned, stored, and insured, they are practically nonperishable, and that the committee therefore recommends that warehouse receipts for tobacco and naval stores be accepted as security for loans on a basis that has due reference to their market value less such allowance as the lenders shall consider reasonable in view of the present suspension of the export demand.

Your committee recommends that notes having not longer than four months to run, when secured by proper warehouse receipts for the aforesaid commodities, properly insured, be accepted for rediscount by the Federal reserve banks, when organized, and that they also be approved by the National currency associations as security for additional circulation to the National banks under the provisions of the Aldrich-Vreeland Act, as amended by the Federal reserve act.

That a subcommittee be appointed by you for the purpose of conferring with the Treasury Department and the banking interests with a view of carrying into effect the recommendations herein made.

A suggestion by Mr. W. G. P. Harding, of the Federal Reserve Board, found considerable favor and was submitted to the Secretary of the Treasury as a recommendation to be followed in towns served wholly or chiefly by State banks. This was to the effect that responsible warehousing firms or corporations be requested to issue their notes as trustees to parties storing cotton, tobacco, or naval stores, with a maturity of not longer than four months, setting forth on their face that they are secured by a pledge of the commodity stored and certifying that the commodity is properly insured for the protection of the holders of the notes. A draft of such a note is shown herewith:

[Face of note.]

$20.00. No. 2409.

WARRANT WAREHOUSE COMPANY,
Cottontown, Ala., September 1, 1914.

On or before four months I promise to pay to the order of myself

TWENTY DOLLARS

At the Farmers' State Bank of Cottontown, Alabama, with interest from date at 6 per cent per annum, having pledged as security for this note, and equally and ratably for two additional notes of same tenor and date for $10 each, one bale of cotton of the grade and weight certified by the Warrant Warehouse Company. Said Warrant Warehouse Company is hereby constituted trustee for the benefit of the holders of the obligations against this bale of cotton and is authorized and empowered at any time after the maturity of this note to sell said cotton at public or private sale, and to apply the proceeds to the liquidation of this and the other notes thereby secured, accounting to me for the balance, if any, after all charges are paid. If before the maturity of this note, the value of cotton should decline, the trustee is authorized to call for additional security, and in event of noncompliance, this obligation shall be held to be immediately due and payable, and authority is given for the immediate sale of the cotton.

Warrant Warehouse Company hereby certifies that it has received as security for this note one bale of cotton marked "J J," weight 506 pounds, grade middling.

WARRANT WAREHOUSE COMPANY,
.... *President.*

These notes when practicable should bear a statement on their reverse side showing that they are receivable by the banks at their face value for debts in the town where the warehouse is located. They may also show that they are receivable by merchants and other business men whose names appear on the reverse side in payment of obligations or for goods purchased.

[Reverse side of note.]

> This note is receivable at its face value in payment of obligations due us.
>
> FARMERS' STATE BANK.
> BANK OF COMMERCE.
> PEOPLES' BANK.
>
> And is receivable at its face value in payment of obligations and all purchases of goods by the following merchants:
>
> JOHN SMITH & COMPANY.
> PETER BROWN & COMPANY.
> FARMERS' FERTILIZER COMPANY.
> MIDDLETON SUPPLY COMPANY.

These notes are not in any case to be regarded as a circulation medium, but are to be held by the banks as loans which can be negotiated by them with National banks, which can in turn pledge them with the National currency associations established under the National banking laws as security for additional currency or for discount to the Federal reserve banks when these have perfected their organizations.

It is reported that growers are being discouraged by market conditions from picking the crop already made on the plants. They hesitate to add to the accrued production cost an additional charge of about $15 per bale for picking, ginning, and wrapping.

High-grade early season cotton, picked before unfavorable weather has had an opportunity to injure it, commands the cream of the market at any time, and especially so in times like the present. Hence, if cotton is to be picked at all the early season part of the crop is the one to gather. It is always worth from 1 to even 4 or 5 cents per pound more than the low grades of the late season. The differential in price this year will probably be greater than in normal years. If we wait and fill our warehouses later with low-grade staple there is danger of a further depression of the market.

Growers and others proposing to warehouse cotton would do well to put in storage a reasonable proportion of early pickings. Those who feel unable to bear the additional cost of ginning and baling should store as much cotton in the seed (without ginning) on the farm in such buildings as furnish reasonable protection. Seed cotton to be stored in this manner should be picked as dry as possible and after the dew is gone, in order to lessen the danger of heating.

Middling cotton, which on July 27 found ready sale at better than 13 cents per pound, is now selling at between 7 and 8 cents. This bare fact is a sufficient call upon every interest, especially in the cotton States, to take such steps as will assist toward the deliberate and proper marketing of the crop. However, the question is of National and not sectional importance.

THE HOG SUPPLY.

The number of stock hogs in the United States on September 1 is estimated by the Bureau of Crop Estimates of the Department of Agriculture as 100.8 per cent of the number in the country a year ago. A year ago, however, the number was relatively short. Therefore the present supply may be regarded as below a normal supply, but the downward tendency of numbers appears to have been checked.

The decline, as compared with a year ago, is almost entirely in the five States of Minnesota, Iowa, South Dakota, Nebraska, and Kansas. Nearly all other States have the same or more than a year ago.

The condition as to health and quality of hogs is estimated as somewhat higher than either of the past two years, although slightly below the average of the past 10 years.

Detailed estimates, by States, are shown on page 28.

THE APPLE CROP.

The condition of the apple crop on September 1 in the United States is estimated at 61.9 per cent of normal, compared with a 10-year average of 53.6 per cent. This condition is interpreted as forecasting a total production of about 220,000,000 bushels. The forecast on August 1 was 210,000,000 bushels. These estimates are based upon a reported total production of 145,000,000 bushels in 1909 by the United States Census, and taking into account changes in condition since then. Such statements of total production of apples should not be confounded with estimates of "commercial" crop, which last year was only about 40 per cent of the total agricultural production.

Comparative statistics of production and prices, by States, are given on pages 29 and 30.

The average yield per acre of wheat in the United States during the five years 1909–1913 was 14.7 bushels, which was 3.6 bushels per acre above the average reported for 1866–1870. This apparent increase in average yield, applied to the acreage of wheat in 1914, equals 192,000,000 bushels.

THE 1914 CROPS OF ENGLAND AND WALES.

According to the preliminary estimate of the British Board of Agriculture and Fisheries, the area and production of cereals, pulse, and potatoes in England and Wales in 1914, as compared with the final data for 1913, are as follows:

Area and production of certain crops in England and Wales, 1914.

Crop.	Area (acres).		Production (Winchester bushels).	
	1914	1913	1914	1913
Wheat	1,843,000	1,702,000	60,406,000	54,812,000
Barley	1,536,000	1,559,000	50,668,000	52,177,000
Oats	1,937,000	1,975,000	75,094,000	77,395,000
Beans	299,000	268,000	8,912,000	7,548,000
Peas	171,000	164,000	3,590,000	3,480,000
Potatoes	470,000	442,000	107,520,000	108,067,000

As estimated by the same authority, the number of live stock in England and Wales on June 4, 1914, as compared with that on the corresponding date of the preceding three years, was as below:

Number of specified kinds of live stock in England and Wales.

	1914	1913	1912	1911
Cattle	5,880,000	5,717,000	5,842,000	5,914,000
Sheep	17,457,000	17,130,000	18,053,000	19,331,000
Pigs	2,516,000	2,102,000	2,497,000	2,651,000

MARKETING THE APPLE CROP.

By CLARENCE W. MOOMAW, *Specialist in Cooperative Organization, Office of Markets.*

According to investigations conducted by the U. S. Department of Agriculture, it is estimated that the commercial apple crop of 1914 will be much larger than that of last year, but not so great by several million barrels as in 1912. Present indications are that the problem of distribution will be rather complex, owing to the heavy yield and uncertain conditions resulting from the European war.

The United Kingdom and the Continent in the past have taken only a small percentage of American apples, less than 2,000,000 barrels annually from the United States, and little more from Canada, but the influence of those markets upon prices of the better grades of market apples has been potent. It is desirable that growers and shippers optimistically prepare for disposal of Europe's usual portion in other ways, and relieve their minds of any idea that the present prosperity of the apple industry is dependent upon open markets across the Atlantic.

The chief effect of the war upon the apple market is a feeling of uneasiness among dealers who have been accustomed to buy for export, or for distribution at home through the winter. Another factor is the influence upon credit, which makes it more difficult for growers and shippers to finance the deal.

Ocean transportation has been seriously crippled, but latest announcements of steamship companies indicate that fairly regular schedules will be maintained between America and the United Kingdom. However, granting that transportation can be satisfactorily arranged, America can not expect Europe to draw her usual portion. It will hardly be possible to reach Germany, and even where markets are open, the demand for apples will be greatly curtailed owing to the fact that fruit is somewhat of a luxury, and consequently its sale is seriously affected in hard times.

The conclusion is that America must either consume her apples or find new markets for the surplus. It should be remembered that the home markets, which always have consumed practically the entire crop, are still open, and that with judicious handling from orchard to consumer the demand can be stimulated and the crop marketed with relative success to all, even granting Europe does not draw a single package. It would appear that simple confidence and good sense are required for solving the problem of distribution.

As to just what constitutes judicious handling, the Office of Markets, in answering inquiries from various parts of the country, strongly urges:

First, that growers pick and handle the fruit in such condition as to insure it against deterioration.

Second, that growers, associations, and operators who use the barrel as a container adopt the standard barrel and uniformly grade and pack the crop in compliance with the standards of the Sulzer law, branding their packages accordingly.

Third, that all inferior grades be eliminated from the green-fruit markets, and diverted as far as possible to cider mills, canneries, and evaporators.

Fourth, that only long-keeping, standard-packed varieties be placed in cold storage.

Fifth, that a special effort be made to fully supply small towns by direct sales, for the purpose of securing equitable distribution and avoiding the congestion of large markets.

Sixth, that all growers, operators, dealers, and associations early reconcile themselves to the conditions, and arrive at an estimate of true values in order to assure quick movement of the crop from producer to consumer.

In explanation, it is suggested that growers should not attempt to harvest the crop at one picking, but rather should glean the trees for only such fruit as is ready to come off, repeating the process until the crop has been picked in uniform condition. The advantage is that the shipping period may begin earlier and last longer, thereby securing greater time for effecting distribution. Furthermore, if all the fruit is harvested at the same time, it is to be remembered that shipments represent extreme stages of maturity, ranging from ripe to green in the same package, and that frequently toward the end of the season over-ripe condition of a portion of the crop results from failure to take off first only what is in condition for marketing.

Careful handling from orchard to cars is necessary to prevent deterioration. It is not difficult to understand why a lot of fruit does not arrive in the market in prime condition if it is picked and piled on the ground in the hot sun, placed in packages in a heated condition, and finally hauled without cover and springs over rough roads. With proper facilities, apples picked to-day should not be packed until to-morrow. For this purpose shelter should be provided in order that the fruit may be packed in a cool, dry condition. Growers who have no packing sheds should either build such or arrange to use their barn floors. The wagons should be equipped with springs, and cover provided for protection from the elements.

In preparing the fruit for shipment, it is desirable that both the optional and mandatory laws be observed; first, for the sake of avoiding trouble, and second, for the good effect such observance will have in establishing confidence in the markets among dealers and consumers.

Reference has been made to the Sulzer law, with the terms of which it is supposed the majority of growers and shippers are familiar. Those who grade, pack, and brand their barrels in accordance with its provisions should be more successful in making quick and satisfactory sales than otherwise. When apples are packed in a standard barrel as established by section 1 of the Sulzer law, and are plainly and conspicuously marked as containing one barrel of apples of one of the standard grades described in section 2, such a statement, if true, would constitute a satisfactory compliance with the net-weight amendment to the Food and Drugs Act. Otherwise the package, if intended for interstate commerce, must be marked to comply with the net-weight amendment to show the quantity of the contents, either by weight or by dry measure or by numerical count. A statement of numerical count must be qualified by the size of the apples expressed as the average diameter in inches to be a statement of quantity.

Indications are that inferior grades will meet with a very poor demand, and that it will be more profitable to keep these grades at home, or for delivery to by-product plants. Such grades will not only move very slowly, but under the circumstances of a large yield would undoubtedly interfere with profitable disposition of the better grades.

It has been a custom in some States to ship a large portion of the crop in bulk. Such fruit, as a rule, is handled as an "orchard run" without respect to grades. Those who ship in bulk should exercise especial care this year to eliminate such stock as is likely to affect results for really good fruit.

Those experienced in handling apples very well remember the ruinous effect of overripe low grades in years when the yield is heavy. It is to be remembered that under the circumstances little profit accrues to any one from such fruit, but that disaster frequently results by congesting the markets with stocks that are not sufficiently good even to justify the expense of handling. The elimination of inferior grades from the green-fruit markets is very imperative this year for successful disposition of the commercial crop, and it is desirable that all parties to the deal strictly adhere to this principle.

For the benefit of those who may not be disposed to exercise especial care in preparing the fruit for market on the grounds that it will not be worth while, it is suggested that under conditions prevailing at this time the difference between proper and improper handling will probably be the difference between success and failure.

What will more largely affect the situation than anything else are opening prices in the primary markets. If the growers and operators hold for arbitrarily high prices, the crop will not pass readily into consumption, and before conditions could be adjusted congestion would undoubtedly occur throughout the channels of trade, with disastrous results to all concerned. Both in the primary and secondary markets the fruit should be offered at prices that will assure early trading and a quick movement, so as to avoid abnormal accumulation at shipping point and in the market. Such accumulation not only causes a depression in values, but, due to delay, over-ripe condition frequently arises and the trade finds itself dealing in partially decayed fruit at ruinous prices.

Owing to geographical location, some important apple-producing States have the natural advantage of an early season. It would be folly for such States not to profit by that advantage. It is possible for growers so situated to leave their crop on the trees until the period of greatest movement, and frequently in years past they have suffered great loss by doing so. The southern States of the apple belt should begin early and market the greatest portion possible prior to the period of greatest movement, and thereby avoid competition with the producing areas of the northern belt. On the other hand, States that go to market latest should be in no hurry to rush the markets during the period of greatest movement. In brief, the crop should be distributed throughout the longest time possible, cold and dry storages being judiciously utilized for conservation.

Regarding the suggestion that only long-keeping standard-grade varieties be placed in cold storage, it is explained that prices which are likely to rule in the early winter will hardly justify accumulated charges on short-keeping and low-grade varieties. Dry-storage apples from the North and Northwest are likely to limit the sale of cold-storage fruit until midwinter. At no time is it profitable to cold store inferior grades, and especially is this true in times of bountiful production.

Small towns outside of the apple belt are often poorly supplied, even in large crop years. Growers of the Middle West have taken advantage of this condition by going to such towns with cars of apples and selling on the track. In order to succeed with this method the shippers should know conditions of supply and demand in the town selected, ascertain the railway and township regulations controlling track sales, and precede delivery of the car with judicious advertising. The mayor can give information as to whether or not a license is required, and the railway agent as to whether or not track sales are allowed.

With reference to the exportation of apples, especial care is urged with respect to Europe. It is shown to what a limited extent, even in normal times, that Continent draws upon America for its fruit requirements. Under present conditions it will be very easy to over-supply these markets, and it is to be remembered ocean freight rates have substantially increased. Exporters are advised carefully to watch the movement and assure themselves of steamer space and a demand on the other side before consigning fruit to countries directly affected by the war.

Inquiries have been received at the Office of Markets regarding Latin America as an outlet for apples. The demand for this fruit has steadily increased, notwithstanding poor transportation facilities and high ocean freight rates. South America has been supplied chiefly through the medium of English dealers, a few shipments being made direct or via the United Kingdom. If arrangements could be made for direct transportation at reasonable rates, it is suggested that substantial sales in Latin America would develop as a possibility for improving distribution of the crop.

The Department of Commerce has expressed a desire to aid in every practicable way with the distribution of American apples in foreign countries, and it is suggested that by cooperating with that department export shippers can probably increase their trade to an appreciable extent in Latin America and the Orient. Inquiries should be addressed to the Bureau of Foreign and Domestic Commerce. It is announced that if the facts desired are not on file in that bureau, the Department of State would be requested to send the inquirer a list of consular officers from whom specific information may be secured. The following publications regarding this subject may be obtained at the prices shown upon application to the Superintendent of Documents, Washington, D. C.: Special Agents' Series, No. 62, 50 cents; No. 72, 10 cents; and No. 81, 25 cents; Special Consular Reports, No. 62, 10 cents; and Tariff Series No. 19a, 5 cents. Remittances should be in cash or by money order. Stamps are not accepted.

In so far as the apple grower is concerned, cooperation in distribution and marketing is highly commended as an economic system for securing judicious handling. Of course, it would be impracticable for growers to organize upon the eve of crop movement, because disaster would likely result as the consequence of too little time for perfecting business arrangements. However, in communities where cooperative packing and selling agencies are operated, the growers should do all possible to strengthen such exchanges with their patronage and counsel. The disloyalty of members is the chief element of failure in cooperative circles, and apple growers are strongly urged to stand by their associations as the best way to solve present and future problems that are common to all.

For the benefit of those who may not be familiar with the Sulzer law the context follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the standard barrel for apples shall be of the following dimensions when measured without distention of its parts: Length of stave, twenty-eight and one-half inches; diameter of head, seventeen and one-eighth inches; distance between heads, twenty-six inches; circumference of bulge, sixty-four inches outside measurements, representing as nearly as possible seven thousand and fifty-six cubic inches: *Provided*, That steel barrels containing the interior dimensions provided for in this section shall be construed as a compliance therewith.

SEC. 2. That the standard grades for apples when packed in barrels which shall be shipped or delivered for shipment in interstate or foreign commerce, or which shall be sold or offered for sale within the District of Columbia or the Territories of the United States shall be as follows: Apples of one variety, which are well-grown specimens, hand picked, of good color for the variety, normal shape, practically free from insect and fungous injury, bruises, and other defects, except such as are necessarily caused in the operation of packing, or apples of one variety which are not more than ten per centum below the foregoing specifications shall be "Standard grade minimum size two and one-half inches," if the minimum size of the apples is two and one-half inches in transverse diameter; "Standard grade minimum size two and one-fourth inches," if the minimum size of the apples is two and one-fourth inches in transverse diameter; or "Standard grade minimum size two inches," if the minimum size of the apples is two inches in transverse diameter.

SEC. 3. That the barrels in which apples are packed in accordance with the provision of this act may be branded in accordance with section two of this act.

SEC 4. That all barrels packed with apples shall be deemed to be below standard if the barrel bears any statement, design, or device indicating that the barrel is a standard barrel of apples, as herein defined, and the capacity of the barrel is less than the capacity prescribed by section one of this act, unless the barrel shall be plainly marked on end and side with words or figures showing the fractional relation which the actual capacity of the barrel bears to the capacity prescribed by section one of this act. The marking required by this paragraph shall be in block letters of size not less than seventy-two point one-inch gothic.

SEC. 5. That barrels packed with apples shall be deemed to be misbranded within the meaning of this act—

First. If the barrel bears any statement, design, or device indicating that the apples contained therein are "Standard" grade and the apples when packed do not conform to the requirements prescribed by section two of this act.

Second. If the barrel bears any statement, design, or device indicating that the apples contained herein are "Standard" grade and the barrel fails to bear also a statement of the name of the variety, the name of the locality where grown, and the name of the packer or the person by whose authority the apples were packed and the barrel marked.

SEC. 6. That any person, firm, or corporation, or association who shall knowingly pack or cause to be packed apples in barrels or who shall knowingly sell or offer for sale such barrels in violation of the provisions of this act shall be liable to a penalty of one dollar and costs for each such barrel so sold or offered for sale, to be recovered at the suit of the United States in any court of the United States having jurisdiction.

SEC. 7. That this act shall be in force and effect from and after the first day of July, nineteen hundred and thirteen.

Approved August 3, 1912.

CONDITION, PRODUCTION, FORECAST, AND PRICES OF SPECIAL CROPS, BY STATES.

TABLE 9.—*Corn and wheat: Condition, forecast, and price of corn, and price of wheat, Sept. 1, 1914, with comparisons.*

State.	Corn.									All wheat.		
	Condition Sept. 1.		Forecast from conditions.		Final estimates.		Price, Sept. 1.			Price, Sept. 1.		
	1914	10-year average.	Sept. 1.	Aug. 1.	1913	5-year average, 1909-1913.	1914	1913	5-year average.	1914	1913	5-year average.
	P. c.	*P. c.*	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Me.	80	87	621	630	608	694	101	89	82	......	......	......
N. H.	89	88	906	877	814	967	93	83	80	......	......	......
Vt.	92	87	1,925	1,822	1,665	1,792	93	82	80	105	107	113
Mass.	91	89	2,184	2,160	1,944	2,041	91	85	81	......	......	......
R. I.	96	91	454	430	402	430	115	105	95	......	......	......
Conn.	93	89	2,898	2,613	2,348	2,755	100	85	84	......	......	......
N. Y.	90	80	21,546	20,131	15,020	18,682	92	81	78	103	89	97
N. J.	93	86	11,130	10,877	10,862	10,157	95	84	82	103	95	100
Pa.	91	84	65,235	61,227	57,057	56,524	89	81	78	101	89	95
Del.	88	86	6,761	6,341	6,206	6,089	90	73	78	110	88	93
Md.	85	84	23,669	24,193	22,110	22,211	88	77	80	101	88	94
Va.	73	85	42,912	46,469	51,480	46,959	95	85	88	102	93	99
W. Va.	77	84	20,855	19,471	22,692	20,137	92	84	86	106	95	104
N. C.	85	85	53,978	51,767	55,282	47,884	102	95	96	108	97	108
S. C.	82	83	35,629	33,022	38,512	31,564	104	102	100	122	117	119
Ga.	83	87	59,059	55,501	63,023	53,482	103	99	97	114	120	125
Fla.	78	86	8,586	8,366	10,125	8,628	93	90	89	......	......	......
Ohio.	81	83	142,408	137,592	146,250	154,651	81	72	71	102	86	94
Ind.	69	85	153,666	149,212	176,400	186,900	79	70	67	97	83	90
Ill.	64	82	288,033	289,171	282,150	366,883	78	73	66	97	84	89
Mich.	85	80	59,685	60,387	56,112	54,829	77	72	69	101	85	93
Wis.	87	84	62,858	66,470	66,825	56,346	71	65	66	97	84	93
Minn.	89	85	90,566	90,566	96,000	76,584	68	63	58	102	79	91
Iowa.	81	82	365,289	396,341	338,300	352,236	72	66	61	90	78	85
Mo.	57	76	156,558	181,856	129,062	200,859	82	77	71	93	81	88
N. Dak.	83	80	12,457	13,057	10,800	6,938	62	52	62	98	76	88
S. Dak.	76	83	75,039	74,749	67,320	60,509	65	60	58	92	74	85
Nebr.	65	74	172,093	195,698	114,150	164,878	70	72	60	89	72	80
Kans.	53	64	107,549	133,478	23,424	129,700	79	81	67	90	75	83
Ky.	74	84	92,374	76,942	74,825	92,543	91	86	81	98	92	95
Tenn.	79	84	80,718	69,178	68,675	80,767	93	83	82	98	95	98
Ala.	76	86	49,613	44,593	55,360	49,107	101	96	93	120	104	113
Miss.	75	83	55,036	50,408	63,000	51,103	93	86	86	......	92	107
La.	74	82	38,004	36,252	41,800	35,131	83	83	76	......	......	......
Tex.	66	73	123,151	115,154	163,200	120,286	85	77	76	87	84	96
Okla.	42	65	53,865	50,274	52,250	75,412	77	77	67	87	75	85
Ark.	65	80	41,405	36,236	47,025	48,439	90	82	80	87	82	92
Mont.	82	86	989	1,081	882	533	85	115	118	83	66	81
Wyo.	91	85	535	480	493	268	105	62	75	84	70	91
Colo.	88	82	10,164	10,979	6,300	6,409	71	70	75	81	73	86
N. Mex.	96	80	2,649	2,643	1,572	1,838	79	76	93	105	77	97
Ariz.	90	89	583	687	476	457	115	115	112	160	108	109
Utah.	97	93	370	366	340	254	80	85	84	75	66	81
Nev.	96	92	34	34	34	29	......	......	......	92	90	113
Idaho.	88	93	598	605	448	362	......	67	80	74	65	72
Wash.	86	87	991	993	952	800	90	74	83	80	69	77
Oreg.	79	89	556	627	598	542	81	85	90	81	75	81
Cal.	93	88	2,288	2,288	1,815	1,745	77	86	91	90	92	96
U. S.	71.7	79.4	2,598,417	2,634,214	2,446,988	2,708,334	81.5	75.4	71.2	93.3	77.1	87.7

[1] Thousands; 000 omitted.

Table 10.—*Spring wheat and flaxseed: Condition, forecast, and price Sept. 1, 1914, with comparisons.*

State.	Spring wheat.						Flaxseed.						
	Condition Sept. 1.		Forecast from condition.		Final estimates.		Condition Sept. 1.		Forecast from Sept. 1 condition.	5-year average, 1909–1913, final estimates.	Price, Sept. 1.		
	1914	10-year average.	Sept. 1.	Aug. 1.	1913	5-year average, 1909–1913.	1914	10-year average.			1914	1913	5-year average.
	P. ct.	*P. ct.*	*Bush.*[1]	*Bush.*[1]	*Bush.*[1]	*Bush.*[1]	*P. ct.*	*P. ct.*	*Bush.*[1]	*Bush.*[1]	*Cts.*	*Cts.*	*Cts.*
Me.	95	95	77	77	76	77	...	...	...	...	...	...	...
Vt.	95	90	27	27	24	24	...	...	...	...	...	...	...
Wis.	81	84	1,684	1,783	1,916	1,719	87	85	108	118	135	135	167
Minn.	56	80	40,582	45,148	67,230	59,859	79	83	2,912	3,315	145	130	171
Iowa.	75	85	4,717	4,978	5,865	5,548	83	85	267	221	138	115	163
Mo.	...	...	...	...	...	...	62	71	48	96	125	120	134
N. Dak.	70	72	81,592	88,513	78,855	90,231	76	78	6,977	8,535	144	129	168
S. Dak.	65	74	35,853	36,613	33,075	38,768	75	82	2,652	3,842	147	123	166
Nebr.	66	76	3,916	4,130	4,200	3,687	80	83	57	24	125	114	157
Kans.	79	56	921	822	468	618	69	72	283	316	124	105	146
Okla.	...	...	...	...	...	...	...	67	...	[2] 6	...	...	...
Mont.	77	88	9,249	10,210	8,385	5,618	55	87	2,059	2,988	120	130	166
Wyo.	80	93	1,320	1,320	1,250	1,019	...	...	...	...	...	...	...
Colo.	91	86	7,204	7,442	5,460	5,266	87	...	63	40	...	...	...
N. Mex.	95	84	750	760	570	477	...	...	...	...	...	...	...
Ariz.	86	89	...	...	...	[2] 48	...	...	...	...	...	...	...
Utah.	91	95	1,856	1,979	1,820	1,853	...	...	...	...	...	...	...
Nev.	95	97	795	820	713	568	...	...	...	...	...	...	...
Idaho.	86	89	5,237	5,603	5,600	4,483	...	...	...	...	...	...	...
Wash.	87	80	22,509	22,546	20,900	22,227	...	...	...	...	...	...	...
Oreg.	82	82	3,193	3,349	3,412	3,399	...	...	...	...	...	...	...
U. S.	68.0	76.6	221,482	236,120	239,819	245,479	72.9	80.4	15,426	19,501	139.3	127.8	167.4

[1] Thousands; 000 omitted.

[2] Four years.

TABLE 11.—*Oats and barley: Condition, forecast, and price, Sept. 1. 1914, with comparisons.*

State.	Oats.								Barley.							
	Condition Sept. 1.		Forecast from condition.		5-year average, 1909–1913, final estimates.	Price Sept. 1.			Condition Sept. 1.		Forecast from condition.		5-year average, 1909–1913, final estimates.	Price Sept. 1.		
	1914	10-year average.	Sept. 1.	Aug. 1.		1914	1913	5-year average.	1914	10-year average.	Sept. 1.	Aug. 1.		1914	1913	5-year average.
	P.c.	*P.c.*	*Bush.*[1]	*Bush.*[1]	*Bush.*[1]	*Cts.*	*Cts.*	*Cts.*	*P.c.*	*P.c.*	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*	*Cts.*
Me.	97	94	5,608	5,596	5,029	51	54	58	95	92	150	147	118	87	79	83
N. H.	97	92	454	445	430	64	58	60	92	89	27	26	25	92	90	88
Vt.	100	92	3,278	3,147	2,869	58	57	58	97	92	402	367	372	90	92	88
Mass.	94	91	325	321	284	60	54	59	....	....	......	......	......	....	....	....
R. I.	78	86	55	56	57	58	....	....	....	....	......	......	......	....	....	....
Conn.	92	87	385	374	342	60	55	59	....	....	......	......	......	....	....	....
N. Y.	83	86	37,288	39,450	39,681	56	47	49	84	85	1,953	2,025	2,081	72	73	76
N. J.	91	85	2,195	2,195	1,990	52	47	53	....	....	......	......	......	....	....	....
Pa.	82	86	31,939	32,061	34,464	50	46	47	81	87	167	175	179	76	63	65
Del.	65	84	94	89	119	....	50	45	....	....	......	......	......	....	....	....
Md.	75	85	1,090	1,008	1,285	53	46	48	87	88	144	139	121	60	70	63
Va.	56	83	2,674	2,621	3,839	57	51	53	83	91	274	280	263	80	68	72
W. Va.	57	84	1,756	1,602	2,558	54	52	55	....	....	......	......	......	....	....	....
N. C.	73	82	3,694	3,594	3,740	63	56	62	....	....	......	......	......	....	....	....
S. C.	77	82	7,347	7,291	7,053	67	68	69	....	....	......	......	......	....	....	....
Ga.	79	85	8,115	7,912	7,810	69	64	68	....	....	......	......	......	....	....	....
Fla.	72	81	648	648	701	65	67	72	....	....	......	......	......	....	....	....
Ohio.	73	81	51,259	51,335	65,129	43	39	38	78	83	1,004	1,002	664	59	54	63
Ind.	63	77	40,098	40,212	54,666	43	38	35	82	83	207	200	242	60	50	58
Ill.	68	77	122,220	125,815	144,625	42	39	35	85	89	1,543	1,520	1,603	58	49	58
Mich.	86	80	50,813	52,389	47,021	42	39	39	89	84	2,323	2,309	2,216	65	59	65
Wis.	69	84	64,832	77,987	74,644	44	37	39	83	85	19,352	19,752	21,351	60	55	65
Minn.	68	82	84,755	92,340	96,426	38	35	34	77	80	32,893	33,623	34,044	55	53	57
Iowa.	82	83	157,629	159,403	166,676	39	36	32	84	85	10,161	10,356	12,395	54	54	57
Mo.	55	72	23,581	24,868	29,307	42	44	38	80	82	114	92	140	....	40	67
N. Dak.	77	77	65,147	71,070	57,063	34	32	36	71	75	26,832	29,172	22,700	49	49	54
S. Dak.	72	78	41,049	41,595	37,027	37	34	33	79	77	20,642	19,426	17,368	53	51	56
Nebr.	86	71	68,979	67,063	54,828	38	40	35	80	72	2,667	2,689	1,981	45	43	47
Kans.	85	64	55,690	56,532	39,612	40	45	41	80	57	5,568	5,314	2,921	45	50	49
Ky.	64	76	2,858	2,903	3,422	53	52	51	90	86	81	78	76	82	75	72
Tenn.	74	82	5,657	5,580	6,126	53	52	50	92	85	54	52	62	85	70	82
Ala.	86	83	6,943	6,862	5,157	65	64	67	....	....	......	......	......	....	....	....
Miss.	84	79	2,984	2,852	2,146	61	64	64	....	....	......	......	......	....	....	....
La.	80	80	1,038	1,070	746	61	57	57	....	....	......	......	......	....	....	....
Tex.	61	70	25,108	25,215	22,651	45	43	48	80	74	218	224	127	52	64	85
Okla.	80	64	33,103	31,406	18,467	40	44	41	80	64	190	197	156	60	67	62
Ark.	75	77	5,445	5,568	4,569	51	51	53	....	....	......	......	......	....	....	....
Mont.	78	90	20,877	23,320	18,878	39	39	45	80	90	1,980	2,076	1,189	55	49	67
Wyo.	86	92	8,533	8,533	6,399	45	47	53	88	93	437	441	327	61	86	80
Colo.	96	88	13,565	13,402	10,397	43	49	51	95	89	3,914	3,955	2,530	57	56	59
N. Mex.	98	84	2,049	1,999	1,415	49	49	55	97	84	144	141	65	77	59	64
Ariz.	94	93	338	335	242	88	55	74	90	95	1,365	1,365	1,294	....	67	78
Utah.	97	97	4,330	4,464	3,825	44	38	47	97	96	1,335	1,362	1,006	51	47	55
Nev.	91	96	491	508	376	55	55	77	94	96	501	512	467	80	85	91
Idaho.	91	92	14,502	14,824	14,061	36	34	43	90	92	7,326	7,779	5,905	50	53	58
Wash.	90	88	14,434	14,324	13,493	39	40	47	92	88	7,200	7,194	6,522	48	50	60
Oreg.	82	87	12,088	12,667	12,906	41	40	44	85	88	3,992	4,255	3,673	50	55	62
Cal.	91	84	8,208	8,389	6,624	43	55	54	96	83	44,415	44,415	37,690	46	66	65
U. S.	75.8	79.1	1,115,548	1,153,240	1,131,175	42.3	39.3	39.1	82.4	80.2	199,575	202,660	181,873	52.5	55.2	59.5

[1] Thousands; 000 omitted.

TABLE 12.—*Potatoes: Condition, forecast, and price Sept. 1, 1914, with comparisons.*

State.	Potatoes.								Sweet potatoes.						
	Cond. Sept. 1.		Forecast from condition.		5-year average, 1909-1913, final estimates.	Price Sept. 1.			Cond. Sept. 1.		Forecast from condition.		5-year average, 1909-1913, final estimates.	Price Aug. 15.	
	1914	10-year average.	Sept. 1.	Aug. 1.		1914	1913	5-year average.	1914	10-year average.	Sept. 1.	Aug. 1.		1914	4-year average.
	P.c.	*P.c.*	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*	*Cts.*	*P.c.*	*P.c.*	*Bu.*[1]	*Bu.*[1]	*Bu.*[1]	*Cts.*	*Cts.*
Me.	99	85	30,413	29,178	26,077	55	58	63	...	...	...	...	...	...	...
N. H.	97	82	2,638	2,474	2,298	91	85	82	...	...	...	...	...	...	...
Vt.	95	82	3,681	3,638	3,414	86	83	87	...	...	...	...	...	...	...
Mass.	97	80	3,798	3,553	2,922	91	91	89	...	...	...	...	...	...	...
R. I.	98	80	784	744	600	86	81	90	...	...	...	...	...	...	...
Conn.	98	78	3,293	3,026	2,437	80	87	92	...	...	...	...	...	...	...
N. Y.	90	76	40,627	40,076	36,288	77	92	89	...	...	...	...	...	...	...
N. J.	83	76	10,080	9,539	8,438	63	70	73	84	87	2,864	2,846	3,066	85	162
Pa.	79	76	25,406	23,295	22,653	78	81	83	88	85	118	120	117	...	159
Del.	67	76	899	909	946	...	72	78	90	86	652	601	657	...	122
Md.	62	77	3,173	3,264	3,383	71	71	73	86	84	991	966	999	70	...
Va.	58	83	6,640	7,079	8,137	84	76	78	75	86	2,767	2,902	3,771	90	87
W. Va.	46	82	2,583	2,640	3,889	110	90	90	83	84	212	192	210	110	124
N. C.	56	82	1,680	1,624	2,349	99	71	78	84	87	7,214	6,810	7,737	80	84
S. C.	63	79	668	670	816	106	140	123	80	86	4,339	4,049	4,508	92	94
Ga.	66	83	744	781	928	121	114	113	85	88	6,849	6,383	7,111	101	100
Fla.	85	84	1,216	1,216	918	134	124	128	86	90	2,010	1,986	2,278	100	94
Ohio.	66	74	12,096	11,945	16,193	95	96	91	80	83	102	94	110	130	140
Ind.	51	71	4,552	4,360	7,222	97	90	87	75	81	98	91	118	125	134
Ill.	46	72	6,446	6,634	9,921	97	90	85	61	80	610	531	841	125	113
Mich.	86	77	41,321	38,191	35,273	62	63	70	...	...	...	...	...	...	...
Wis.	84	80	34,474	35,568	31,625	63	45	62	...	...	...	...	...	...	...
Minn.	81	81	29,724	30,841	25,885	51	41	61	...	...	...	...	...	...	...
Iowa.	68	75	12,495	13,406	13,227	90	89	88	75	84	186	190	196	155	186
Mo.	38	72	3,471	3,915	6,034	105	97	91	59	77	425	435	639	135	113
N. Dak.	83	82	6,177	6,190	4,797	67	54	71	...	...	...	...	...	...	...
S. Dak.	78	83	4,981	4,960	4,217	77	72	84	...	...	...	...	...	...	...
Nebr.	70	74	8,354	8,658	7,231	88	85	92	...	78	...	...	...	175	216
Kans.	59	67	4,121	4,103	4,148	95	96	98	75	77	450	472	437	130	150
Ky.	38	81	1,957	1,649	4,000	112	90	83	82	84	790	665	941	100	104
Tenn.	46	83	1,643	1,505	2,691	107	82	81	81	86	1,616	1,343	1,997	90	94
Ala.	66	84	1,176	1,123	1,245	140	109	110	82	88	5,683	4,876	6,014	100	87
Miss.	71	81	929	832	801	105	99	111	78	87	4,204	3,632	4,979	85	84
La.	78	79	1,704	1,587	1,457	103	81	91	86	89	5,000	4,433	5,007	84	80
Tex.	72	71	2,756	2,739	2,691	113	92	111	85	72	4,641	3,567	2,924	105	122
Okla.	72	68	2,212	2,112	1,604	108	93	112	73	75	539	429	352	105	129
Ark.	60	77	1,411	1,391	1,919	112	88	98	80	79	1,642	1,287	1,813	95	94
Mont.	75	86	4,856	5,472	4,215	90	65	84	...	...	...	...	...	...	...
Wyo.	75	86	1,511	1,733	1,094	109	110	121	...	...	...	...	...	...	...
Colo.	83	81	9,387	9,372	8,161	92	78	99	...	...	...	...	...	...	...
N. Mex.	87	77	1,101	1,132	644	97	150	129	...	77	...	...	...	140	245
Ariz.	82	82	98	106	97	110	163	138	...	91	...	...	...	165	...
Utah.	80	89	3,192	3,471	2,722	81	56	67	...	...	...	...	...	...	...
Nev.	86	94	1,775	1,920	1,369	85	85	114	...	...	...	...	...	...	...
Idaho.	81	90	5,288	5,491	5,232	80	53	63	...	...	...	...	...	...	...
Wash.	80	84	8,496	8,826	8,636	68	58	66	...	...	...	...	...	...	...
Oreg.	67	85	4,924	6,394	6,408	64	55	67	...	...	...	...	...	...	...
Cal.	89	88	10,012	10,212	9,375	77	65	77	91	91	956	986	806	99	154
U. S.	75.8	78.0	370,963	369,634	356,627	74.9	75.3	79.7	81.8	85.2	54,958	49,886	57,628	98.4	97.9

[1] Thousands; 000 omitted.

TABLE 13.—*Tobacco, rice, and buckwheat: Condition, forecast, and price, Sept. 1, 1914, with comparisons.*

State.	Tobacco.				Rice.				Buckwheat.					
	Condition Sept. 1.		Forecast from Sept. 1 condition.	5-year average, 1909–1913, final estimates.	Condition Sept. 1.		Forecast from Sept. 1 condition.	5-year average, 1909–1913, final estimates.	Condition Sept. 1.		Forecast from Sept. 1 condition.	5-year average, 1909–1913, final estimates.	Price Sept. 1.	
	1914	10-year average.			1914	10-year average.			1914	10-year average.			1914	5-year average.
	P. ct.	P. ct.	Lbs.[1]	Lbs.[1]	P. ct.	P. ct.	Bu.[1]	Bu.[1]	P. ct.	P. ct.	Bu.[1]	Bu.[1]	Cts.	Cts.
Me.									94	90	384	423		70
N. H.	96	91	182	163					90	93	29	29		77
Vt.	96	86	182	164					92	91	202	200	86	80
Mass.	94	92	11,788	9,524					94	89	44	39		97
R. I.														
Conn.	99	92	37,996	28,337					93	90	60	56	100	99
N. Y.	85	85	5,748	4,997					89	83	6,462	5,766	78	76
N. J.									92	84	244	247	77	84
Pa.	92	86	50,246	57,351					88	87	6,037	5,894	80	70
Del.									82	87	56	65	100	
Md.	76	79	13,680	18,663					84	88	198	198	100	82
Va.	61	83	87,840	135,388					67	86	339	443	80	77
W. Va.	65	79	6,599	12,763					81	87	758	792	78	78
N. C.	73	79	133,042	127,339	83	85	5	14	84	88	166	178	85	86
S. C.	74	81	31,657	22,027	85	83	170	273						
Ga.	80	88	1,368	1,323	88	86	38	64						
Fla.	93	87	3,799	2,987	86	86	10	15						
Ohio	74	79	70,655	79,966					83	84	390	406	72	78
Indiana	73	81	10,840	18,939					74	84	78	94	75	79
Ill.	50	84	279	842					80	83	72	79		98
Mich.									88	83	1,012	1,051	80	71
Wis.	86	84	57,648	47,807					82	85	265	297	78	73
Minn.									84	84	102	125	85	67
Iowa									89	85	104	116	85	92
Mo.	57	78	2,804	5,578					75	82	28	25		93
Nebr.									80	85	18	17		90
Kans.									80	80	14	12		
Ky.	69	78	286,830	350,502										
Tenn.	67	81	48,228	70,426					78	90	44	45	75	77
Ala.	75	87	105	153	88	86	6	10						
Miss.					88	86	44	57						
La.	92	83	380	218	90	88	11,633	11,775						
Tex.	65	79	107	159	88	90	8,320	9,006						
Ark.	80	79	470	471	86	89	3,406	2,730						
Cal.					98		805	[2] 93						
U. S.	71.4	80.6	862,473	996,087	88.9	88.7	24,437	24,016	87.1	85.4	17,106	16,597	79.8	74.0

[1] Thousands; 000 omitted.

[2] Four years.

TABLE 14.—*Hay and clover seed: Yield, quality, and price of hay; acreage and condition of clover seed, Sept. 1, 1914.*

State.	Hay (all tame). Yield per acre.		Hay (all tame). Production.			Hay (all tame). Quality.		Hay (all tame). Price Sept. 1.			Clover for seed.			Timothy. Production.[1]
	1914.	10-year average.	1914 (preliminary).	1913	5-year average.	1914	10-year average.	1914	1913	5-year average.	Acreage, per cent of 1913.	Condition Sept. 1. 1914	Condition Sept. 1. 10-year average.	1914.
	Tons	*Tons*	*Tons.*[2]	*Tons.*[2]	*Tons.*[2]	*P. c.*	*P. c.*	*Dolls.*	*Dolls.*	*Dolls.*	*P. c.*	*P. c.*	*P. c.*	*P. c.*
Me.	1.15	1.12	1,414	1,194	1,299	96	96	13.70	14.70	14.02	100	93	93	97
N. H.	1.15	1.11	598	495	538	94	95	18.60	16.30	15.76	100	90	95	99
Vt.	1.20	1.32	1,188	1,280	1,310	95	96	15.90	13.70	13.06	100	85	92	85
Mass.	1.32	1.23	634	575	582	91	94	19.00	20.10	20.28	90	85	95	93
R. I.	1.17	1.17	68	68	67	88	96	21.00	22.50	22.40	.....	.....	.....	90
Conn.	1.25	1.17	469	432	441	86	94	21.50	18.50	20.52	.....	.....	90	92
N. Y.	1.20	1.22	5,584	5,358	5,498	88	90	14.90	14.00	14.80	75	73	83	82
N. J.	1.35	1.34	487	469	472	85	91	19.20	18.00	17.90	100	90	81	85
Penn.	1.30	1.35	4,083	4,146	3,840	91	90	14.40	13.70	14.98	115	84	77	88
Del.	1.17	1.37	84	94	88	87	88	15.00	15.00	14.54	100	87	85	70
Md.	1.16	1.30	452	491	453	86	87	15.30	12.20	15.64	115	84	79	76
Va.	.72	1.22	459	952	793	79	87	17.10	14.00	15.56	85	70	84	52
W. Va.	.86	1.30	599	925	770	82	86	17.60	14.20	15.20	95	78	86	60
N. C.	1.15	1.44	353	419	375	84	88	18.00	15.50	15.90	95	82	88	70
S. C.	1.15	1.30	242	244	219	87	87	18.00	17.80	17.46	95	90	88	85
Ga.	1.50	1.50	368	350	293	90	88	17.30	18.00	17.74	90	88	87	80
Fla.	1.35	1.36	61	63	52	92	87	18.70	17.00	16.82	.....	.....	.....	.....
Ohio	1.13	1.36	3,178	3,848	3,838	91	90	14.50	11.10	12.76	80	78	75	74
Ind.	1.00	1.28	1,764	1,800	2,194	88	88	14.70	12.40	12.44	70	74	78	65
Ill.	.85	1.25	1,806	2,450	3,168	87	91	14.80	13.30	12.76	60	70	81	54
Mich.	1.28	1.28	3,011	2,520	3,004	93	92	12.20	12.60	13.12	90	84	77	85
Wis.	1.75	1.48	4,364	3,848	3,301	95	93	9.40	10.10	12.84	99	88	84	96
Minn.	1.89	1.54	3,294	2,490	2,265	96	92	6.30	6.50	8.04	105	91	84	93
Iowa	1.34	1.41	3,899	4,440	4,511	96	95	10.30	9.00	9.32	95	86	82	79
Mo.	.70	1.14	1,848	1,800	3,115	79	88	14.10	13.20	10.60	65	63	80	44
N. Dak.	1.45	1.27	528	388	403	94	91	5.00	5.20	5.96	108	90	90	91
S. Dak.	1.70	1.29	821	552	514	96	92	5.80	5.90	6.64	110	92	90	92
Nebr.	1.69	1.40	2,133	1,675	1,591	93	93	7.10	7.50	7.86	100	80	85	89
Kans.	1.51	1.30	2,492	1,350	1,988	88	90	8.40	12.70	8.56	73	75	83	66
Ky.	.95	1.25	699	674	919	83	86	17.40	15.90	14.26	80	55	84	66
Tenn.	1.20	1.42	907	1,089	1,117	85	86	18.60	15.70	14.56	86	75	84	66
Ala.	1.31	1.59	262	286	268	86	88	14.80	14.50	13.66	130	90	89	78
Miss.	1.45	1.57	281	293	275	83	87	12.70	12.10	11.58	110	88	85	85
La.	2.05	1.74	332	240	235	89	89	12.50	12.60	12.06	103	90	90	.....
Tex.	1.75	1.41	735	464	444	89	86	9.80	11.00	10.80	.....	.....	78	.....
Okla.	1.13	1.18	493	382	388	81	87	8.90	10.40	7.96	95	76	.....	80
Ark.	1.15	1.40	350	384	363	85	87	12.90	12.00	11.30	95	85	86	70
Mont.	2.00	1.80	1,372	1,188	1,109	94	94	7.80	8.40	9.80	120	95	94	93
Wyo.	2.30	2.18	1,104	912	819	100	97	9.20	7.50	9.16	112	100	96	95
Colo.	2.40	2.29	2,328	1,824	1,707	95	91	8.40	8.40	9.58	100	95	89	100
N. Mex.	2.50	2.35	510	399	387	92	90	10.30	13.00	11.32	.....	.....	.....	100
Ariz.	3.20	3.27	454	540	350	93	92	12.50	11.50	10.78	.....	.....	.....	.....
Utah	2.75	2.89	1,116	909	943	96	95	8.00	8.50	8.30	90	97	95	98
Nev.	3.25	2.57	803	646	587	98	96	10.30	9.00	9.64	.....	.....	.....	99
Idaho	2.65	2.94	1,868	2,044	1,879	96	96	6.50	6.90	7.66	125	88	94	86
Wash.	2.20	2.27	1,751	1,794	1,620	97	94	9.70	10.20	11.90	105	97	96	90
Oreg.	2.00	2.11	1,716	1,732	1,578	97	95	9.00	8.40	9.46	106	63	89	90
Cal.	1.95	1.77	5,242	3,600	4,017	90	94	7.20	13.30	10.74	98	97	95	97
U.S.	1.42	1.40	68,604	64,116	65,987	92.1	91.7	11.91	11.89	12.04	80.9	77.3	80.1	74.4

[1] Production compared with a full crop.

[2] Thousands; 000 omitted.

TABLE 15.—*Grass crops and stock hogs: Condition Sept. 1, 1914, with comparisons.*

States.	Alfalfa.		Bluegrass seed.		Millet.		Kafir corn.		Canadian peas.		Cowpeas.		Stock hogs.			
	Production.[1]				Condition Sept. 1.								No. for fattening, per cent of 1913.	Condition Sept. 1.		
	1914	8-year average.	1914	8-year average.	1914	8-year average.	1914	8-year average.	1914	8-year average.	1914	8-year average.		1914	1913	10-year average.
	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.
Maine	....	....	....	....	92	89	....	....	95	92	....	....	98	99	98	99
New Hampshire	....	....	....	....	97	88	....	....	....	....	....	....	96	99	100	99
Vermont	....	....	....	....	95	88	....	....	95	88	....	....	98	99	98	99
Massachusetts	....	....	....	....	94	88	....	....	92	....	....	....	95	98	99	98
Rhode Island	....	....	....	....	93	....	....	....	....	....	....	....	97	99	99	99
Connecticut	....	....		....	94	87	....	....	....	....	....	....	95	98	99	100
New York	96	90	....	....	93	82	....	....	89	84	....	82	98	98	99	98
New Jersey	96	90	....	....	93	84	....	....	90	....	90	89	100	97	95	97
Pennsylvania	90	88	....	....	93	87	....	....	90	....	92	87	103	97	97	98
Delaware	90	92	....	....	78	....	....	....	94	80	87	87	102	95	93	96
Maryland	87	86	....	....	78	83	....	....	85	80	84	86	105	96	93	96
Virginia	75	88	76	....	71	84	....	....	70	....	75	85	105	95	95	96
West Virginia	85	87	93	87	83	83	....	....	83	78	84	85	102	97	94	97
North Carolina	83	86	....	....	85	86	....	....	77	81	81	83	105	94	94	94
South Carolina	80	90	....	....	83	82	....	....	69	83	83	83	107	96	90	93
Georgia	81	86	66	....	87	86	....	....	88	....	90	86	102	95	93	94
Florida	....	....	....	....	....	....	....	....	....	....	88	87	105	93	90	91
Ohio	85	88	100	86	79	87	....	....	85	84	82	88	99	96	95	96
Indiana	85	88	70	80	69	85	....	....	65	84	76	84	100	94	91	94
Illinois	85	89	60	84	58	83	50	78	65	84	63	82	100	92	90	95
Michigan	98	87	....	79	90	84	....	....	88	79	81	82	105	97	96	96
Wisconsin	98	89	98	80	90	86	....	87	84	82	79	85	100	97	96	97
Minnesota	140	89	98	84	93	88	....	....	90	85	80	88	92	89	90	96
Iowa	97	90	87	82	86	87	....	....	85	88	85	87	95	92	71	92
Missouri	76	86	65	77	61	78	80	78	65	79	66	80	100	92	90	94
North Dakota	115	89	....	....	90	80	....	....	92	....	....	76	120	94	98	98
South Dakota	140	87	....	....	86	84	....	....	96	....	....	85	96	91	88	95
Nebraska	90	84	....	....	84	81	86	81	50	....	....	82	95	87	87	95
Kansas	85	81	80	76	88	71	83	76	79	....	75	79	95	93	94	95
Kentucky	74	85	90	77	77	82	....	....	76	81	83	85	100	93	93	94
Tennessee	80	87	95	....	82	85	....	....	70	....	84	86	105	93	89	93
Alabama	85	84	....	....	80	86	....	....	82	....	89	84	104	93	92	93
Mississippi	77	82	....	....	84	85	....	....	78	....	83	84	105	94	91	92
Louisiana	80	85	....	....	85	....	....	....	75	....	79	84	100	89	88	92
Texas	90	78	....	....	86	73	92	78	80	80	89	77	110	92	95	95
Oklahoma	75	78	....	....	72	73	75	78	75	....	77	77	105	93	93	95
Arkansas	90	85	60	....	76	80	86	79	75	....	75	81	105	88	87	88
Montana	105	96	....	....	98	87	....	....	86	92	....	....	135	99	99	98
Wyoming	101	95	....	....	60	87	....	....	92	....	....	....	125	98	100	99
Colorado	107	89	....	....	90	79	93	77	101	92	98	90	110	98	98	99
New Mexico	99	90	....	....	94	76	96	77	94	76	91	78	112	98	95	97
Arizona	97	94	....	....	82	98	102	92	....	....	90	82	100	92	95	98
Utah	95	91	....	....	110	94	....	....	100	....	97	92	105	99	100	100
Nevada	102	98	....	....	....	....	....	....	....	....	....	....	100	99	98	100
Idaho	95	96	....	....	95	98	....	....	94	92	....	92	110	98	96	99
Washington	96	95	....	....	....	....	....	....	85	91	87	91	105	99	99	99
Oregon	88	94	....	....	....	87	....	....	88	90	....	92	110	99	99	99
California	98	95	....	....	....	....	96	89	80	87	95	89	102	96	95	98
U. S.	93.8	89.2	....	....	82.1	79.4	84.5	78.8	....	....	....	....	100.8	93.4	89.8	94.6

[1] Production compared with a full crop.

TABLE 16.—*Apples: Forecast and price Sept. 1, 1914, with comparisons.*

State.	Forecast from condition.		Final estimates.		Price to producers, per bushel.				
					Aug. 15.			Sept. 15.	
	Sept. 1, 1914.	Aug. 1, 1914.	1913	1912	1914	1913	1912	1913	1912
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Maine	6,300	5,500	3,000	5,400	52	65	79	75	55
New Hampshire	1,800	1,700	800	2,200	96	95	74	96	65
Vermont	2,600	2,500	700	2,600	70	110	80	105	60
Massachusetts	3,500	3,000	2,300	3,300	80	105	85	100	80
Rhode Island	300	300	300	300	85	92	120	100	100
Connecticut	1,900	1,800	2,100	1,700	85	75	80	60	72
New York	42,300	36,000	19,500	44,000	65	72	65	75	50
New Jersey	2,900	3,000	2,100	1,700	50	73	70	63	60
Pennsylvania	20,600	19,500	10,200	12,700	52	80	65	78	56
Delaware	400	400	200	400	40	60	50	55	55
Maryland	3,300	3,300	1,300	2,600	50	70	50	100	50
Virginia	12,300	12,300	5,200	15,000	42	60	42	65	42
West Virginia	10,600	10,300	1,000	10,300	50	100	48	105	41
North Carolina	7,600	7,200	3,000	7,600	50	73	65	75	65
South Carolina	700	700	300	600	92	115	87	115	100
Georgia	1,700	1,700	900	1,400	68	96	68	85	80
Ohio	11,700	10,500	4,800	10,600	75	98	65	95	55
Indiana	4,000	4,000	6,600	4,200	78	60	65	60	64
Illinois	3,600	4,100	8,200	5,800	100	61	70	60	70
Michigan	14,600	13,100	8,900	17,200	50	50	58	50	50
Wisconsin	2,300	2,500	4,000	2,000	80	65	84	55	65
Minnesota	800	900	1,800	700	140	70	135	60	116
Iowa	1,900	2,500	7,100	1,500	110	59	99	60	87
Missouri	10,200	11,700	7,900	19,200	70	60	50	63	48
South Dakota	200	200	300	200	130	100	127	93	100
Nebraska	1,700	2,200	2,300	2,800	100	80	85	85	85
Kansas	3,600	4,200	2,700	6,700	100	100	60	110	60
Kentucky	7,900	7,100	6,900	9,600	68	70	56	65	56
Tennessee	7,100	5,900	3,900	8,900	50	65	49	75	55
Alabama	1,400	1,200	900	1,200	70	85	83	76	84
Mississippi	400	400	400	400	......	98	87	100	91
Louisiana	......	......	......	......	......	105	92	100	140
Texas	400	400	300	500	500	110	110	110	100
Oklahoma	1,300	1,200	1,100	1,700	100	93	78	100	78
Arkansas	4,300	4,000	4,000	5,100	80	75	70	80	76
Montana	900	900	800	900	100	125	106	100	80
Wyoming	......	......	......	......	120	150	......	125	......
Colorado	3,700	4,400	3,300	3,100	80	82	85	85	88
New Mexico	800	900	600	800	105	105	130	100	100
Arizona	100	100	100	100	120	160	200	190	204
Utah	800	800	600	700	70	100	89	85	75
Nevada	200	200	200	300	150	185	......	180	110
Idaho	1,600	1,500	1,400	1,700	92	92	100	85	80
Washington	7,200	7,600	6,900	7,700	78	95	80	87	65
Oregon	3,300	3,300	3,500	4,100	78	85	80	84	73
California	5,400	5,300	3,000	5,700	80	90	85	100	70
United States	220,200	210,300	145,400	235,200	68.6	75.2	67.5	76.5	62.2

TABLE 17.—*Fruits: Condition Sept. 1, 1914, with comparisons.*

State.	Apples.		Peaches.				Grapes.		Pears.		Watermelons.		Cantaloupes.		Cranberries.		Tomatoes.	
	Cond. Sept. 1.		Production.[1]		Quality.		Cond. Sept. 1.		Cond. Sept. 1.		Production.[1]		Production.[1]		Cond. Sept. 1.		Cond. Sept. 1.	
	1914	10-year average.	1914	10-year average.	1914	1913	1914	10-year average.	1914	6-year average.	1914	8-year average.	1914	8-year average.	1914	8-year average.	1914	8-year average.
	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.
Maine	83	62	....	....	....	....	85	....	80	79	....	....	....	....	87	78	92	88
New Hampshire	78	62	5	74	82	85	75	....	65	82	....	....	....	....	87	77	88	87
Vermont	75	63	....	....	....	....	85	82	70	79	....	....	....	76	....	....	91	88
Massachusetts	86	63	20	55	85	89	96	86	80	80	85	80	88	80	95	76	94	85
Rhode Island	77	64	45	58	88	90	93	80	80	84	80	....	78	85	98	78	94	85
Connecticut	75	66	43	67	87	86	90	81	73	83	84	81	80	81	85	85	94	88
New York	73	54	20	60	87	87	89	81	57	72	87	80	83	78	95	85	91	84
New Jersey	86	59	95	59	88	91	95	83	83	66	85	81	87	80	84	76	84	83
Pennsylvania	80	57	67	50	90	89	90	77	77	67	86	76	88	78	....	....	89	83
Delaware	81	61	76	43	90	86	95	81	50	55	90	78	90	80	....	....	78	78
Maryland	81	61	86	52	89	78	94	77	75	62	82	75	84	75	....	....	79	78
Virginia	78	54	69	47	82	70	90	76	63	53	80	74	78	76	....	....	74	81
West Virginia	87	52	77	45	83	77	86	69	66	50	81	70	80	73	....	....	83	82
North Carolina	81	57	81	55	87	65	91	79	70	54	85	77	84	75	....	....	81	83
South Carolina	73	53	87	57	88	61	87	77	72	59	86	74	80	72	....	....	74	81
Georgia	75	54	89	62	83	66	90	79	74	58	93	82	86	75	....	....	81	85
Florida	....	....	75	66	80	68	....	....	67	57	74	82	68	75	....	....	77	82
Ohio	60	44	57	42	83	78	93	76	65	61	81	73	82	77	....	....	84	84
Indiana	39	48	61	48	78	80	87	79	56	58	75	79	77	80	....	77	75	80
Illinois	28	42	65	42	83	82	80	78	55	47	66	79	69	80	....	....	60	83
Michigan	72	54	43	54	90	83	92	80	79	68	89	80	88	80	85	75	91	84
Wisconsin	49	61	....	....	....	....	88	82	71	62	83	81	86	79	90	78	86	86
Minnesota	42	70	....	....	....	....	80	81	....	....	80	75	86	78	80	....	89	84
Iowa	18	52	59	30	77	80	84	86	55	40	83	81	82	82	....	....	82	83
Missouri	47	47	63	39	78	67	76	72	59	41	72	70	70	70	....	....	58	75
North Dakota	....	....	....	....	....	....	....	....	....	....	75	70	75	....	....	....	78	76
South Dakota	50	70	....	....	....	....	84	76	....	....	84	78	80	77	....	....	86	78
Nebraska	35	56	32	37	74	56	72	72	59	50	80	71	80	71	....	....	78	73
Kansas	42	46	51	40	77	60	63	68	62	40	80	71	82	69	....	....	65	68
Kentucky	64	52	90	49	85	69	88	77	73	52	88	75	85	75	....	....	76	86
Tennessee	74	51	88	48	91	60	82	70	62	48	88	78	84	77	....	....	78	85
Alabama	67	52	77	56	86	62	85	75	66	58	91	80	84	75	....	....	77	84
Mississippi	60	52	72	56	81	66	82	73	68	57	92	79	84	73	....	....	74	83
Louisiana	47	55	45	61	70	70	85	78	70	66	83	80	81	79	....	....	71	81
Texas	62	59	23	58	80	80	73	73	53	61	81	77	80	76	....	....	72	73
Oklahoma	53	58	10	58	70	62	61	68	35	52	79	73	76	72	....	....	54	66
Arkansas	67	55	60	60	85	76	82	71	60	48	83	78	80	77	....	....	72	77
Montana	77	82	....	....	....	....	....	....	....	79	....	80	....	77	....	....	76	79
Wyoming	....	76	....	....	....	....	....	....	....	....	80	....	83	....	....	....	98	82
Colorado	75	67	82	49	90	92	95	77	89	56	93	85	93	85	....	....	95	82
New Mexico	86	67	76	54	90	78	88	74	80	70	93	80	90	78	....	....	89	74
Arizona	80	75	85	71	93	94	87	85	82	82	88	91	90	92	....	....	87	86
Utah	99	76	100	69	98	94	97	86	85	68	97	89	95	88	....	....	96	92
Nevada	65	72	90	57	90	95	96	....	62	59	100	....	100	83	....	....	100	82
Idaho	79	78	80	63	95	94	81	86	77	76	78	90	85	89	....	....	74	84
Washington	80	79	81	73	93	92	90	88	81	81	86	86	83	85	....	....	80	81
Oregon	75	76	88	70	95	94	90	90	79	79	84	85	82	86	....	....	77	84
California	86	78	94	74	95	89	90	88	84	81	95	89	97	90	....	....	91	89
United States	61.9	53.6	63.0	54.3	83.7	74.0	88.9	82.5	67.4	64.2	81.8	77.3	83.7	77.4	88.8	77.0	78.5	80.5

[1] Production compared with a full crop.

TABLE 18.—*Vegetables and miscellaneous: Condition, Sept. 1, 1914, with comparisons.*

State.	Cabbages.		Onions.		Beans (dry).		Lima beans.		Broom corn.		Sugar cane.		Sorghum.		Sugar beets.		Hops.		Peanuts.	
	1914	8-year average.	1914	8-year average.	1914	8-year average.	1914	7-year average.	1914	8-year average.	1914	10-year average.	1914	10-year average.	1914	8-year average.	1914	10-year average.	1914	8-year average.
	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.
Maine	91	88	89	87	92	87	92	88	...	...	...	...	...	...	...	...	...	...	...	...
N. Hampshire	92	84	90	84	91	87	85	84	...	...	...	...	...	...	...	...	...	...	...	...
Vermont	90	88	83	89	93	87	100	89	...	...	...	...	...	...	...	...	...	...	...	...
Massachusetts	93	84	96	81	93	84	93	80	...	...	...	...	...	...	...	...	...	...	...	...
Rhode Island	96	83	90	81	95	80	94	83	...	...	...	...	...	...	...	...	...	...	...	...
Connecticut	95	86	91	82	92	84	92	82	...	...	...	...	...	...	...	...	...	...	...	...
New York	85	80	89	83	85	84	88	82	...	...	...	...	...	...	...	83	70	79	...	...
New Jersey	90	82	84	84	86	84	86	84	...	...	...	...	...	...	...	...	...	...	...	...
Pennsylvania	88	81	86	86	89	83	92	83	...	...	...	...	...	...	...	...	...	...	...	...
Delaware	80	82	87	84	90	...	91	81	...	...	...	...	...	...	...	...	...	...	...	...
Maryland	76	77	82	84	87	81	84	80	...	...	...	...	...	...	...	...	...	...	...	...
Virginia	63	80	70	88	65	80	73	82	70	81	...	...	74	84	...	...	...	...	85	81
West Virginia	78	82	76	88	83	84	80	81	...	79	...	...	83	83	...	...	...	...	...	...
North Carolina	69	80	78	88	75	84	77	84	...	...	...	83	83	85	...	...	...	...	83	83
South Carolina	66	79	70	86	68	80	75	81	...	...	86	86	80	84	...	...	...	...	82	82
Georgia	70	82	78	86	84	84	83	84	...	...	85	87	87	86	...	...	...	...	88	87
Florida	82	...	...	...	...	...	...	...	...	...	88	...	84	84	...	...	...	...	90	88
Ohio	77	85	80	86	81	84	83	85	82	81	...	...	82	85	85	86	...	...	...	...
Indiana	62	78	74	84	70	78	69	79	76	...	...	...	72	83	80	...	...	...	...	...
Illinois	49	77	61	83	51	78	56	79	75	78	...	...	58	81	92	85	...	...	...	...
Michigan	89	83	90	83	82	82	84	79	...	...	...	...	61	84	92	87	...	...	...	...
Wisconsin	86	82	88	83	90	86	92	84	...	...	...	...	85	86	90	88	93	87	...	...
Minnesota	80	82	86	85	88	86	93	84	...	...	...	...	92	87	89	88	...	...	...	...
Iowa	68	78	78	83	80	82	80	82	77	86	...	...	82	85	87	...	...	...	...	...
Missouri	45	68	64	79	52	72	55	71	62	76	...	...	61	80	...	...	...	...	...	...
North Dakota	80	78	83	80	90	80	85	...	...	...	...	...	...	...	...	...	...	...	...	...
South Dakota	78	77	80	81	75	82	78	...	...	...	...	...	87	...	...	...	...	...	...	...
Nebraska	68	69	76	76	78	78	78	78	87	80	...	...	85	82	90	86	...	...	...	...
Kansas	57	65	78	75	68	72	71	71	83	72	...	...	86	80	90	80	...	...	...	...
Kentucky	64	79	76	88	68	81	68	80	73	82	...	...	80	82	...	...	...	...	...	...
Tennessee	70	82	78	89	74	82	72	83	81	82	...	...	82	85	...	...	...	...	77	82
Alabama	72	80	78	86	76	83	78	85	...	81	83	86	86	84	...	...	...	...	84	86
Mississippi	65	77	77	85	...	81	68	82	67	86	80	87	83	82	...	...	...	...	86	85
Louisiana	68	76	81	84	90	81	83	81	...	...	81	91	86	88	...	...	...	...	87	89
Texas	65	68	79	80	82	75	82	73	88	76	83	81	92	78	...	...	...	...	84	79
Oklahoma	47	58	75	74	65	66	60	64	77	71	...	...	75	80	...	...	...	...	73	72
Arkansas	58	72	76	84	70	74	68	73	75	84	79	82	80	82	...	...	...	...	82	80
Montana	86	90	86	91	82	92	90	...	...	...	...	...	...	...	89	94	...	...	...	...
Wyoming	85	89	93	86	92	92	85	...	...	...	...	...	...	...	96	95	...	...	...	...
Colorado	92	87	92	89	95	86	97	87	90	80	...	...	95	83	95	92	...	...	...	...
New Mexico	92	81	93	84	95	81	92	67	94	...	...	...	95	80	95	...	...	...	75	71
Arizona	90	87	91	88	90	83	90	...	...	...	...	...	96	90	...	87	...	...	...	89
Utah	95	90	96	94	95	90	95	93	...	...	...	...	95	92	99	96	...	...	...	...
Nevada	94	90	96	93	95	...	...	...	...	...	...	...	...	...	98	...	...	...	...	...
Idaho	83	90	86	94	82	91	84	87	...	...	...	...	...	...	96	92	...	...	...	...
Washington	83	84	88	89	84	88	...	88	...	...	...	...	...	...	87	91	88	92	...	...
Oregon	75	89	88	91	81	90	82	92	...	...	...	...	...	...	87	92	78	90	...	...
California	91	90	93	92	91	88	95	90	...	...	...	...	...	...	92	91	90	91	95	91
U.S.	78.4	80.7	81.9	84.4	84.5	83.6	81.2	83.8	78.1	75.0	81.8	89.1	79.7	82.2	92.5	89.8	77.8	87.9	85.5	84.3

PRICES OF FARM PRODUCTS.

TABLE 19.—*Prices paid to producers of farm products, by States.*

State.	Aug. 15, 1914.										Sept. 1, 1914.					
	Hogs.		Beef cattle.		Sheep		Milch cows.		Horses.		Butter.		Eggs.		Chickens.	
	1914	4-year average.	1914	4-year average.	1914	4-year average.	1914	4-year average.	1914	4-year average.	1914	5-year average.	1914	5-year average.	1914	5-year average.
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Maine	8.10	7.60	7.50	7.15	5.10	4.42	60.00	49.78	200	201	31	30	30	28	14.4	14.7
N. Hampshire	9.00	8.22	8.00	6.80	7.00	5.83	60.00	54.48	170	180	33	31	32	30	16.0	14.2
Vermont	8.10	7.18	5.80	5.17	4.10	3.62	58.00	47.30	170	164	31	30	27	27	14.3	13.4
Massachusetts	10.50	8.43	8.00	6.67	.....	.....	80.00	52.25	250	210	36	34	38	34	19.5	16.8
Rhode Island	9.30	8.38	.....	.....	4.25	.....	76.00	68.12	250	230	35	33	34	36	17.0	18.0
Connecticut	11.30	9.00	9.60	8.37	8.50	7.00	72.00	62.97	200	211	34	33	33	34	18.0	16.4
New York	8.70	7.50	6.50	5.42	4.50	4.25	65.40	54.50	172	180	31	29	29	27	16.2	15.1
New Jersey	8.30	8.38	8.00	6.33	5.00	4.67	76.50	61.25	170	174	33	32	31	29	18.7	17.6
Pennsylvania	8.90	7.92	7.70	6.15	5.60	5.55	63.80	50.42	180	173	30	28	26	24	15.7	13.5
Delaware	9.10	7.50	6.20	5.60	5.50	4.30	53.00	45.20	130	140	.....	26	25	23	15.0	14.5
Maryland	8.20	7.98	7.00	5.78	5.50	4.53	55.00	40.62	137	150	26	25	23	22	16.0	14.7
Virginia	8.20	7.12	6.50	4.90	4.50	3.80	48.90	37.08	146	139	23	23	21	19	14.8	13.9
West Virginia	8.20	7.40	6.70	5.10	4.50	3.85	54.00	41.45	146	140	25	23	21	20	14.1	12.9
North Carolina	8.40	7.42	5.40	4.20	4.70	4.38	39.50	33.48	155	149	24	23	20	18	13.3	11.6
South Carolina	7.80	7.38	4.80	3.78	5.70	4.60	42.00	38.35	173	176	25	25	20	20	12.8	12.2
Georgia	8.20	6.98	4.70	4.02	4.20	4.25	39.30	32.70	160	156	24	24	20	19	13.9	12.7
Florida	7.10	6.35	5.40	4.98	5.90	5.33	46.00	40.35	145	146	33	31	25	24	17.5	14.2
Ohio	8.90	7.88	7.30	5.82	4.50	3.65	63.00	49.68	158	166	27	24	22	20	13.3	12.0
Indiana	8.90	7.85	7.20	5.58	4.10	3.58	55.60	46.20	141	151	24	22	20	19	12.3	11.1
Illinois	8.80	7.60	7.50	5.80	4.50	3.82	62.50	50.65	142	154	27	24	19	17	12.3	11.2
Michigan	8.40	7.58	6.60	5.12	4.70	4.25	61.00	46.15	172	173	26	24	22	20	13.0	11.2
Wisconsin	8.30	7.30	6.40	4.60	4.90	3.90	74.90	49.28	172	172	29	26	21	19	12.7	11.7
Minnesota	8.00	7.18	6.10	4.45	4.90	3.90	63.40	43.85	155	162	27	25	21	18	11.4	10.4
Iowa	8.50	7.50	7.80	6.02	5.10	4.00	64.80	49.62	149	164	26	24	20	16	11.8	10.3
Missouri	8.20	7.38	6.90	5.62	4.10	3.75	58.00	45.65	115	126	23	21	17	15	11.6	10.4
North Dakota	7.10	6.62	6.20	4.35	5.10	4.48	65.50	46.50	136	147	23	22	19	17	11.6	10.3
South Dakota	7.80	7.00	6.90	5.10	5.20	4.18	66.60	46.30	124	135	25	23	18	17	10.2	9.2
Nebraska	7.20	7.18	7.60	5.62	5.70	4.35	70.00	48.50	130	131	23	21	17	15	11.0	9.7
Kansas	8.40	7.35	7.40	5.52	5.20	4.32	62.80	46.75	118	128	24	22	17	15	10.1	9.4
Kentucky	8.00	7.32	6.30	4.85	3.80	3.50	49.00	39.20	121	131	21	19	16	15	12.0	11.1
Tennessee	7.70	6.90	5.90	4.18	3.90	3.52	46.10	36.65	137	145	18	18	16	16	11.8	10.8
Alabama	7.20	6.90	4.50	3.35	4.70	3.82	39.20	31.05	138	138	23	21	18	17	13.2	11.6
Mississippi	6.70	6.68	4.50	3.48	4.00	3.32	40.20	31.10	125	121	22	21	17	17	12.9	11.5
Louisiana	6.80	6.10	6.00	4.12	5.80	4.18	40.00	33.10	110	96	29	26	19	18	14.0	13.2
Texas	7.40	6.85	5.60	4.32	4.60	4.22	57.00	42.80	92	94	23	21	17	15	10.7	9.6
Oklahoma	7.90	7.18	5.80	4.40	4.60	4.35	55.00	42.45	98	107	23	21	16	14	10.1	9.0
Arkansas	6.40	6.12	4.90	3.70	3.60	3.55	42.10	30.88	98	111	23	21	16	16	11.0	10.2
Montana	7.50	7.52	6.50	5.93	5.10	4.43	80.00	57.25	122	141	30	31	26	29	13.2	14.2
Wyoming	8.50	7.32	7.80	5.12	5.80	4.80	83.00	58.12	92	94	27	28	25	26	10.6	14.3
Colorado	8.10	7.42	6.50	5.22	5.50	4.68	70.00	54.30	105	120	28	28	26	25	14.0	13.4
New Mexico	7.20	7.45	6.40	5.20	5.40	4.37	59.50	50.32	65	82	34	31	29	28	14.0	14.0
Arizona	7.90	7.63	6.20	5.07	3.80	4.13	94.00	60.00	101	112	34	34	31	31	19.4	17.0
Utah	7.30	7.12	6.00	5.10	5.40	5.02	68.20	46.82	120	115	30	29	22	23	13.1	13.4
Nevada	8.30	8.17	6.10	6.50	5.20	4.17	80.00	69.50	140	135	36	36	37	34	22.0	20.2
Idaho	7.70	7.42	6.10	5.22	4.40	4.18	78.00	56.32	110	142	27	30	22	27	12.0	12.4
Washington	7.90	8.12	6.60	5.58	5.10	4.58	80.00	62.82	123	150	31	31	29	29	13.8	13.8
Oregon	7.90	8.02	6.10	5.60	4.50	4.42	68.00	54.28	98	121	33	31	27	27	13.7	12.6
California	8.20	7.20	6.40	5.62	5.10	4.50	70.00	54.02	127	145	29	30	29	28	16.0	14.5
United States	8.11	7.30	6.47	5.08	4.87	4.31	60.72	46.48	135.21	142.69	25.3	24.3	21.0	19.1	12.7	11.6

TABLE 20.—*Averages for the United States of prices paid to producers of farm products.*

Product.	Aug. 15.					Sept. 15.		July 15.		
	1914	1913	1912	1911	1910	1913	1912	1914	1913	1912
Hogs.....per 100 lbs..	$8.11	$7.79	$7.11	$6.54	$7.78	$7.68	$7.47	$7.72	$7.81	$6.64
Beef cattle.....do....	6.47	5.91	5.37	4.39	4.64	5.92	5.35	6.38	5.98	5.17
Veal calves....do....	8.08	7.53	6.62	5.93	6.29	7.73	6.83	7.80	7.46	6.33
Sheep..........do....	4.87	4.32	4.26	3.98	4.68	4.23	4.11	4.75	4.20	4.21
Lambs.........do....	6.26	5.50	5.60	5.25	5.70	5.51	5.49	6.55	6.05	5.74
Milch cows.per head..	60.72	54.78	46.11	42.26	42.77	55.78	46.79	59.67	54.80	45.41
Horses.........do....	135.00	141.00	142.00	141.00	148.00	141.00	141.00	137.00	143.00	142.00
Honey, comb.per lb..	.135	.138	.137	.136	.135	.138	.135	.135	.139	.139
Wool, unwashed, per lb..............	.187	.158	.188	.160	.195	.158	.187	.185	.159	.189
Peanuts......per lb..	.049	.049	.050	.053	.045	.049	.048	.052	.051	.049
Apples......per bu..	.69	.75	.68	.73	.74	.76	.62	.91	.86	.82
Peaches........do....	1.05	1.26	1.08	1.38	1.11	1.36	1.10	1.20	1.30	1.12
Pears..........do....	.99	1.10	1.06	1.18	....	1.19	1.00	....	....	....
Beans..........do....	2.54	2.11	2.40	2.20	2.27	2.08	2.38	2.22	2.22	2.47
Sweet potatoes.do....	.98	.99	1.02	1.07	.83	.90	.89	.94	.89	1.13
Tomatoes......do....	.92	.96	....	....	....	.68	.59	1.67	1.61	1.27
Onions.........do....	1.38	1.05	1.00	1.16	1.00	1.04	.89	1.70	1.02	1.14
Cabbages.per 100 lbs..	1.74	2.15	1.88	2.47	1.89	1.79	1.25	2.66	2.64	2.29
Clover seed..per bu..	8.76	9.37	9.80	9.65	7.53	7.31	9.39	8.12	9.78	10.64
Timothy seed..do....	2.43	2.01	3.20	6.52	....	2.13	2.09	2.32	1.94	5.96
Alfalfa seed....do....	6.81	7.96	8.58	....	....	7.42	9.02	6.92	8.20	8.32
Broom corn.per ton..	91.00	91.00	83.00	72.00	142.00	106.00	77.00	88.00	57.00	85.00
Cotton seed....do....	20.16	20.24	18.02	20.45	....	21.07	17.61	22.78	21.37	19.04
Hops..........per lb..	.200	....	.188	.365	....	.209	.198	.147	.148	.289
Paid by farmers:										
Clover seed, per bu..........	10.39	11.94	11.78	....	....	10.22	11.61	9.79	12.12	12.82
Timothy seed, per bu..........	3.17	2.76	3.89	....	....	2.84	3.06	2.99	2.57	6.59
Alfalfa seed, per bu..........	7.79	10.06	10.07	....	....	8.96	10.52	8.29	9.41	10.07
Bran ...per ton..	27.24	25.10	27.41	25.92	25.19	26.59	26.82	26.36	24.C5	28.41

TABLE 21.—*Range of prices of agricultural products at market centers.*

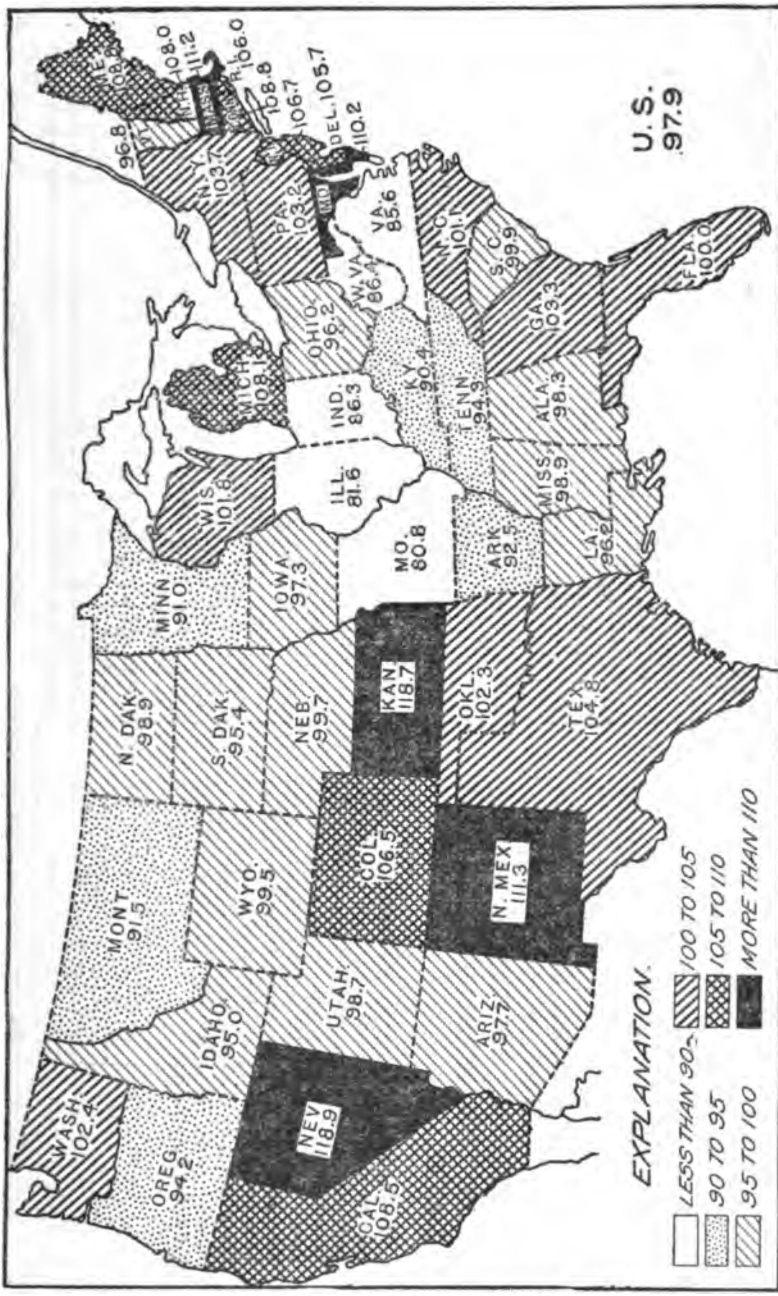
Products and markets.	Sept. 1, 1914.	Aug., 1914.	July, 1914.	Aug., 1913.	Aug., 1912.
Wheat per bushel:					
No. 2 red winter, St Louis........	$1.10 -$1.11½	$0.80 -$1.14	$0.76 -$0.91	$0.84¾-$0.92½	$0.98 -$1.12
No. 2 red winter, Chicago..........	1.12 - 1.13	.85¼- 1.16	.77¾- .95½	.84 - .90½	1.00 - 1.07⅝
No. 2 red winter, New York [1].....	1.19 - 1.19	.95 - 1.22	.88½- 1.02½	94¼.- .97	1.07 - 1.10
Corn per bushel:					
No. 2 mixed, St. Louis............	.79 - .79½	.77½- .87	.67 - .77½	.69½- .78½	.71½- .80½
No. 2, Chicago..................	.79¼- .80¼	.74 - .86	.67½- .76	.68½- .78¼	.73½- .83
No. 2 mixed, New York [1].........	.88½- .88½	.82 - .93½	....	....	.81¾- .83
Oats per bushel:					
No. 2, St. Louis...................	.50 - .50½	.34 - .50	.35 - .38½	.44 - .39½	.29½- .39½
No. 2, Chicago...................	.48 - .49	.33½- .48¾	.34⅝- .39½	.39½- .42⅜	.31 - .35
Rye per bushel: No. 2, Chicago.......	.96 - .96½	.67 - 1.01	.55 - .72	.61 - .70½	.68 - .75½
Baled hay per ton: No. 1 timothy, Chicago..............................	14.50 -15.00	15.00 -18.50	14.50 -18.00	16.50 -19.00	15.00 -22.00
Hops per pound: Choice, New York..	.35 - .37	.35 - .37	.35 - .38	.19 - .20	.23 - .30
Wool per pound:					
Ohio fine unwashed, Boston......	.25 - .26	.25 - .25	.24 - .25	.20 - .21	.23 - .25
Best tub washed, St. Louis.......	.32 - .33	.32 - .33	.32 - .33	.29 - .30	.35 - .36
Live hogs per 100 pounds: Bulk of sales, Chicago........................	9.05 - 9.45	7.90 - 9.90	8.50 - 9.50	7.75 - 9.00	7.50 - 8.65
Butter per pound:					
Creamery, extra, New York......	.31½- .32	.28½- .32	.26¾- .29½	.26½- .30	.26 - .27½
Creamery, extra, Elgin...........	.28 - .30½	.28 - .30½	.26 - .28	.26 - .27½	.25 - .25
Eggs per dozen:					
Average best fresh, New York....	.30 - .37	.27 - .36	.24 - .31	.27 - .36	.24 - .32
Average best fresh, St. Louis.....	.21½- .21¼	.19 - .21½	.18 - .19	.14 - .17	.15½- .19½
Cheese per pound: Colored,[2] New York..................................	.16 - .16½	.14½- .16¼	.14 - .14½	.13¾- .15¼	.15 - .16¼

[1] F. o. b. afloat.

[2] September colored—September to April, inclusive; new colored May to July, inclusive; colored Augus..

TABLE 22.—*The equivalent in yield per acre of 100 per cent condition on Oct. 1 in each State.*

State.	Corn.	Buck-wheat.	Pota-toes.	Sweet pota-toes.	Tobac-co.	Flax.	Rice.	Cotton.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Lbs.*	*Bush.*	*Bush.*	*Lbs.*
Maine	50.0	34.5	240	...	...	...	...	...
New Hampshire	50.0	32.0	162	...	1,850	...	...	...
Vermont	50.0	28.0	160	...	1,850	...	...	...
Massachusetts	50.0	23.5	150	...	1,850	...	...	...
Rhode Island	44.0	...	162	...	...	...	...	...
Connecticut	51.0	22.0	142	...	1,850	...	...	...
New York	46.0	27.5	126	...	1,470	...	...	...
New Jersey	44.2	27.0	132	155	...	...	...	...
Pennsylvania	49.4	25.2	122	137	1,600	...	...	...
Delaware	39.0	23.0	123	148	...	...	...	...
Maryland	42.5	22.0	122	146	870	...	...	...
Virginia	30.6	23.0	111	121	900	...	...	310
West Virginia	37.4	27.0	118	129	900	...	...	...
North Carolina	22.4	22.0	100	115	820	...	31.8	330
South Carolina	22.0	...	107	114	940	...	30.5	310
Georgia	17.5	...	94	105	900	...	33.0	264
Florida	16.0	...	110	124	930	...	30.0	170
Ohio	46.0	24.5	118	131	1,080	...	...	...
Indiana	45.0	21.5	120	132	1,040	...	...	...
Illinois	44.0	22.5	116	126	930	...	...	...
Michigan	41.5	20.4	137	...	...	...	...	...
Wisconsin	42.5	19.5	140	...	1,470	15.5	...	...
Minnesota	40.0	20.5	134	...	...	12.0	...	...
Iowa	44.0	20.0	130	127	...	12.4	...	...
Missouri	38.0	19.5	107	125	1,160	9.6	...	390
North Dakota	32.0	...	125	...	...	11.1	...	...
South Dakota	34.0	...	104	...	...	10.5	...	...
Nebraska	35.5	22.5	105	120	...	10.1	...	...
Kansas	32.0	18.0	101	127	...	9.2	...	...
Kentucky	34.2	...	102	112	1,030	...	...	...
Tennessee	31.0	19.3	98	109	920	...	...	275
Alabama	20.2	...	100	112	700	...	34.5	255
Mississippi	22.5	...	110	114	...	...	36.5	295
Louisiana	25.5	...	92	104	590	...	38.0	290
Texas	28.5	...	92	110	820	...	39.5	255
Oklahoma	31.5	...	100	128	...	13.0	...	280
Arkansas	26.5	...	102	119	820	...	43.0	281
Montana	34.0	...	175	...	...	12.1	...	...
Wyoming	28.5	...	160	...	...	...	...	...
Colorado	26.0	...	160	...	...	9.5	...	...
New Mexico	31.5	...	125	185	...	...	...	...
Arizona	36.5	...	120	155	...	...	...	...
Utah	35.0	...	194	...	...	...	...	...
Nevada	35.0	...	172	...	...	...	...	...
Idaho	34.5	...	197	...	...	...	...	...
Washington	33.5	...	185	...	...	...	...	...
Oregon	32.0	...	150	...	...	...	...	...
California	41.0	...	150	180	...	...	54.0	...
United States	35.0	25.6	132.4	116.5	1,004	11.3	39.2	279.9



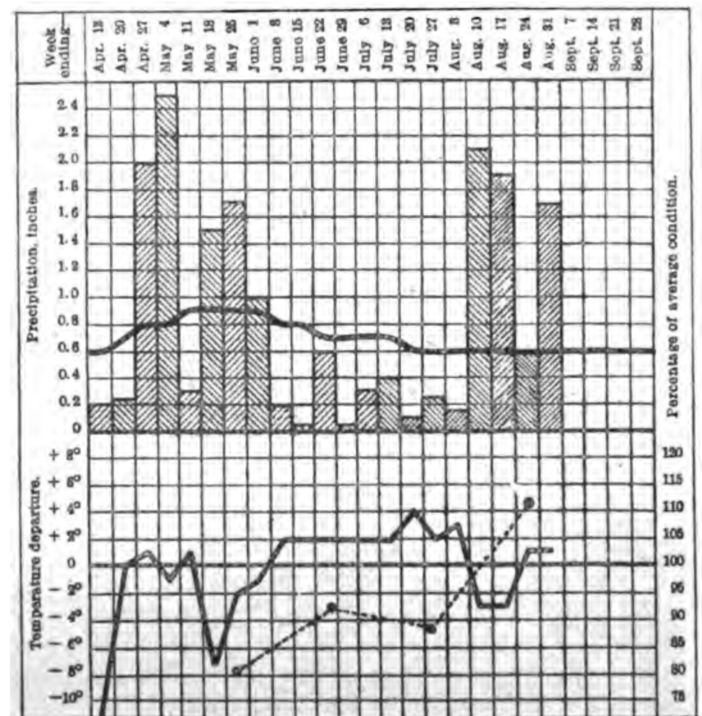
Crop conditions September 1, 1914: Composite of all crops (weighted), 100 representing the 10-year average (not normal) condition on August 1.

DIAGRAMS SHOWING WEEKLY WEATHER CONDITIONS AND THE PROGRESS OF CROPS IN THE PRINCIPAL COTTON, CORN, AND WHEAT REGIONS, FOR THE SEASON APRIL 6 TO DATE.

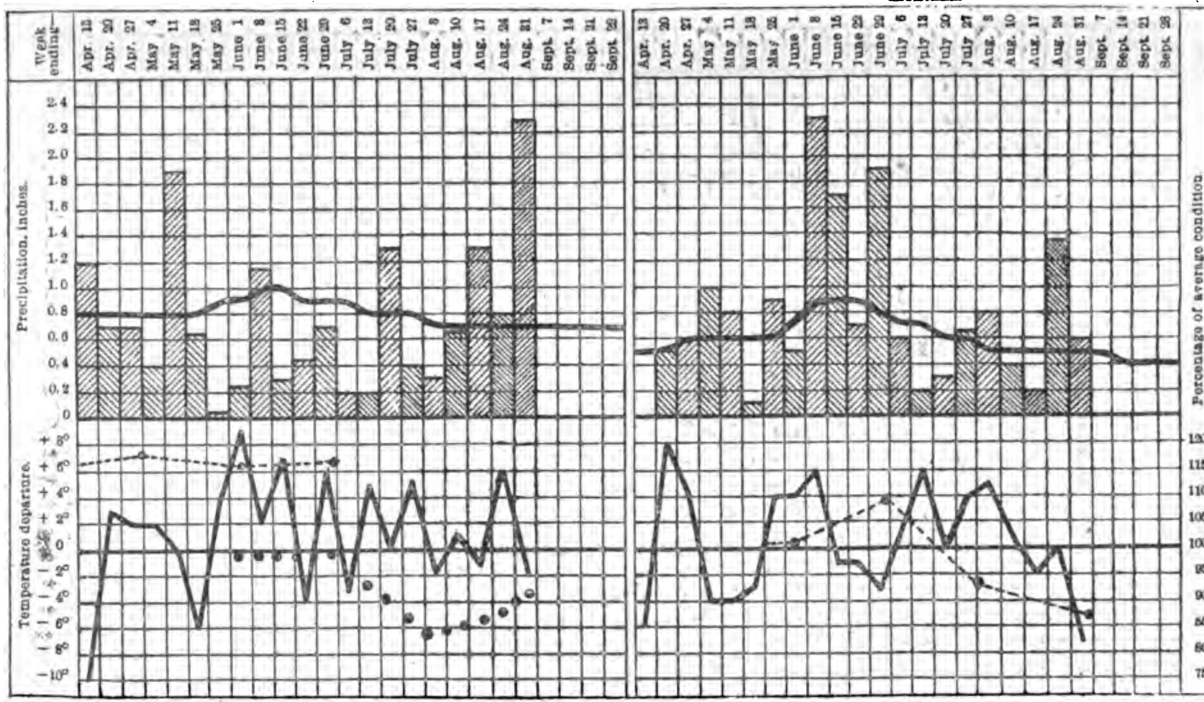
The diagrams shown on this and the following page indicate graphically by weeks the progress of the season's weather as compared with the normal in the several principal crop-growing districts, especially the cotton, and corn and wheat regions. They also show the percentage of the average condition by months, when available, of the corn, wheat, and cotton crops on the dates and for the States indicated on each chart, as reported by the Bureau of Crop Estimates, U. S. Department of Agriculture.

COTTON REGION.

Western Section: Texas and Oklahoma.



Eastern Section: Michigan, Ohio, Indiana, Kentucky, and Tennessee. **Spring wheat region: Minnesota, North Dakota, South Dakota, and Montana.**



Shaded blocks in upper part of each diagram show average weekly precipitation as indicated by figures at left, and the heavy solid line indicates the normal weekly precipitation.

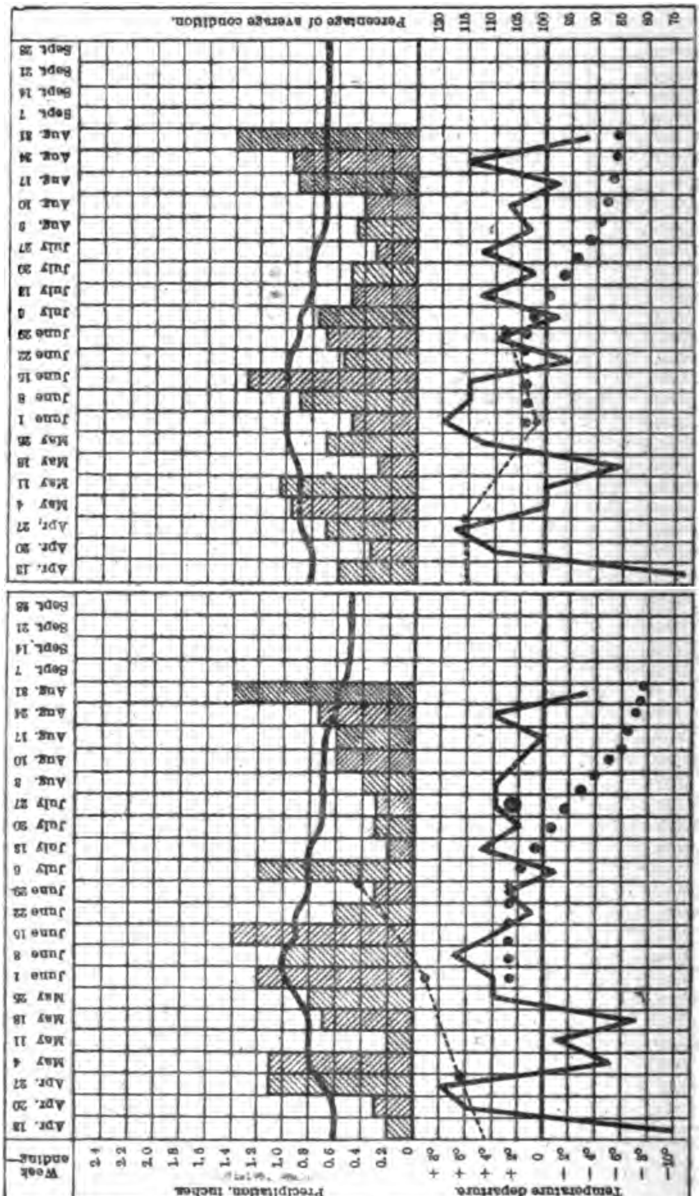
The weekly temperature departures from the normal are shown by the heavy black line in the lower part of each diagram, the amount of departures, in degrees, being indicated by the figures on the left. The percentage of the average condition of wheat on the dates indicated, is shown by the dotted line, the amounts above or below 100 per cent being indicated by the figures on the right.

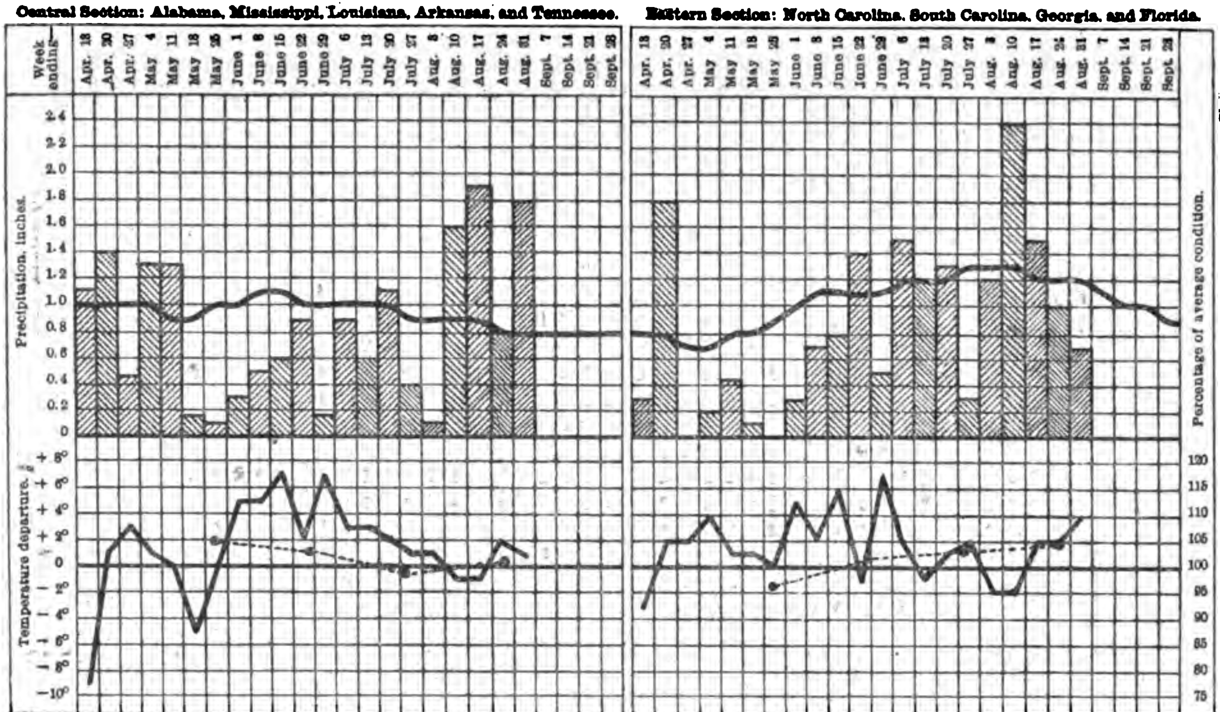
●●●● Average condition of corn to August 1.

CORN AND WHEAT REGIONS.

Western Section: South Dakota, Nebraska, Kansas, and Oklahoma.

Central Section: Wisconsin, Minnesota, Iowa, Illinois, Missouri, and Arkansas.





Shaded blocks in upper part of each diagram show average weekly precipitation as indicated by figures at left, and the heavy solid line indicates the normal weekly precipitation.

The weekly temperature departures from the normal are shown by the heavy black line in the lower part of each diagram, the amount of departures, in degrees, being indicated by the figures on the left. The percentage of the average condition of cotton on the dates indicated, is shown by the dotted line, the amounts above or below 100 per cent being indicated by the figures on the right.

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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

621

Contribution from the Bureau of Biological Survey, Henry W. Henshaw, Chief.
December 14, 1914.

HOW TO ATTRACT BIRDS IN NORTHEASTERN UNITED STATES.

By W. L. McAtee, *Assistant Biologist.*

INTRODUCTION.

The means of increasing the number of birds about our homes are few and simple. They comprise adequate protection and the provision of suitable nesting places, food, and water. It is planned in a series of publications, of which this bulletin relating to Northeastern United States (fig. 1) is the first, to recommend practicable methods of attracting birds about homes in the various parts of the United States. Especial attention will be given to the value of fruit-bearing shrubs and trees, as there is available less information relating to these as a means of attracting birds than concerning more widely known but not more important measures, as protection, winter feeding, and the supplying of nesting boxes and water. Furthermore, the last-named measures need not vary so much with the locality as does choice of fruit-bearing shrubs and trees.

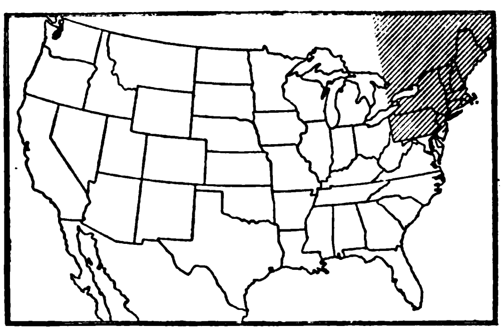

Fig. 1.—Map of the United States, the shaded area showing the territory to which this bulletin applies.

PROTECTION.

Protection is the prime requisite for increasing the number of birds in any area, and the results of protection are in direct proportion to the amount given. Besides insuring birds against every form of persecution by human kind, we must defend them from various natural foes. The most effectual single step is to surround the pro-

Note.—Means of providing a food supply for wild birds about the homestead are especially described in this bulletin.

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posed bird sanctuary with a vermin-proof fence (fig. 2). Such a fence should prevent entrance either by digging or by climbing, but will serve its greatest use if it can not be climbed, and is therefore cat-proof. If it is impracticable to build an impenetrable fence, the next best device is to put guards (fig. 3) of sheet metal on all nesting trees and on poles supporting bird houses. This should be done in any case where squirrels or snakes are likely to intrude, as it is usually impracticable to fence out these animals. Tree guards should be 6 feet or more above ground. Attacks by hawks, owls, crows, jays, or other enemies are best controlled by eliminating the destructive individuals. Those who wish to combat English sparrows will find full directions for so doing in Farmers' Bulletin 493, "The English Sparrow as a Pest," by Ned Dearborn, 1912.

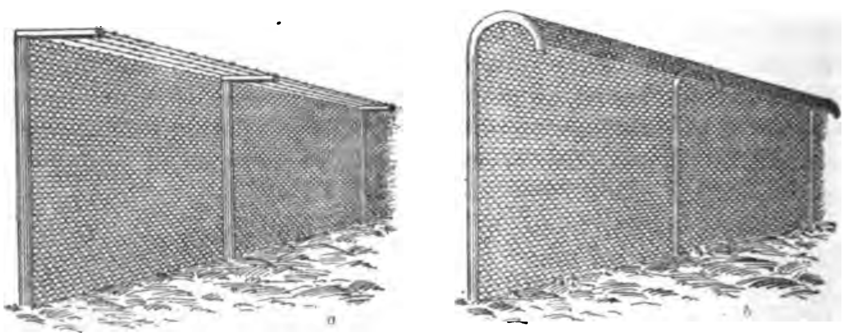


FIG. 2.—Cat-proof fence; a, With barbed wires; b, with loose overhanging netting.

BREEDING PLACES.

Although a considerable number of our native birds build their nests on the ground, the majority place them in trees or shrubs, either in holes or on the limbs or in crotches. Shrubbery and trees for nesting sites, therefore, are essential for making a place attractive to birds, and a double purpose is served if the kinds planted are chosen from the list of fruit-bearing species given further on. Shrubs should be allowed to form thickets and should be pruned back severely when young so as to produce numerous crotches.

Constant removal of old trees and modern tree-surgery have resulted in a great diminution in the number of tree cavities, the natural homes of most of our hole-nesting birds. Fortunately most of these birds will utilize artificial nest cavities, or bird houses. The sizes useful for various birds, plans for making, and illustrations of numerous bird boxes are given in Farmers' Bulletin 609, "Bird Houses and How to Build Them," by Ned Dearborn, 1914. The most common errors in putting out bird houses are choosing poor locations and supplying too many boxes. A bird house in a bald, glaring location is not nearly so likely to attract tenants as one in a partially shaded place. Martins, only, prefer a house standing apart from trees. Entrances to boxes should be sheltered by projecting roofs and should face away from the prevailing wind and rain storms.

All bird houses should be constructed so that the interior may easily be examined and cleaned. This is not only important to permit last year's rubbish to be thrown out, but is necessary in much of the area for which the present bulletin is written to facilitate inspection for gypsy-moth egg masses and cocoons.

As a rule birds do not like being crowded, and if a place is studded with bird houses only a few of them will be occupied. Birds not only do not want bird neighbors too near, but they are impatient of human meddling, and therefore should be granted as much privacy as possible during the actual incubating and brooding. Nests built in shrubbery are especially likely to come to a bad end if the birds are frequently disturbed.

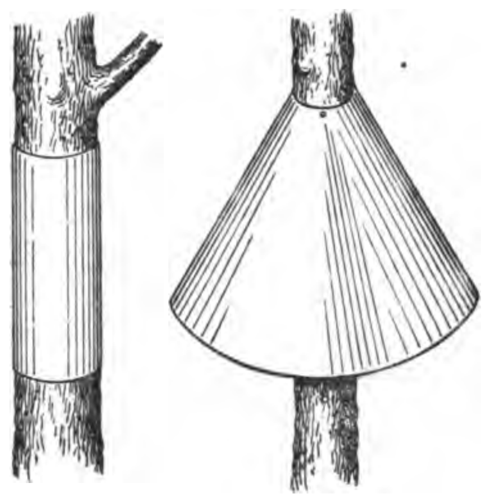


Fig. 3.—Tree guards.

If we would protect ground-nesting birds, as bobolinks, meadowlarks, and bobwhites, grass in the nesting fields must not be cut during the breeding season.

WATER SUPPLY.

Nothing has a more potent attraction for birds during hot weather than drinking and bathing places. The birds' water supply should be a pool not more than a few inches deep, the bottom sloping gradually upward toward the edge. Both bottom and edge should be rough, so as to afford a safe footing. A giant pottery saucer (fig. 4, *a*) is an excellent device, or the pool may be made of concrete, or even metal, if the surface be roughened (fig. 4, *b*). The bird bath may be elevated, or on the ground if on an open space where skulking enemies can not approach too near.

A water supply is appreciated in winter as well as in summer.

FOOD.

Food supply is the vital factor in bird life and the most important single offering we can make in our efforts to attract birds. It is important to note that an ample supply of food prior to and during the nesting season tends to increase the number of eggs laid and also the number of broods in a season. Bird food may be supplied in two ways—by planting trees, shrubs, and herbs which produce seeds or fruits relished by birds, and by exposing food in artificial devices. The most familiar phase of the latter method is winter feeding.

ARTIFICIAL FOOD SUPPLY.

During the season when the natural food supply is at its lowest ebb birds respond most readily to our hospitality. Winter feeding has become very popular, and the result has been to bring about better understanding between birds and human kind.

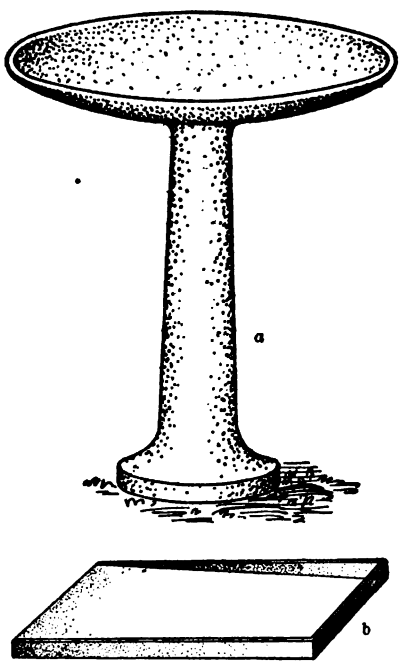


FIG. 4.—Bird baths: *a*, Pottery; *b*, metal or concrete.

The winter foods commonly used include suet or other fat, pork rinds, bones with shreds of meat, cooked meats, meal worms, cut-up apples, birdseed, buckwheat, crackers, crumbs, coconut meat, cracked corn, broken dog biscuits or other bread, hemp seed, millet, nut meats of all kinds (especially peanuts), whole or rolled oats, peppers, popcorn, pumpkin or squash seeds, raw or boiled rice, sunflower seeds, and wheat.

The methods of making these supplies available to birds are as varied as the dietary itself. A device very commonly used is the food tray or shelf (figs. 5 and 6). This may be put on a tree or pole, by a window or at some other point about a building, or strung upon a wire or other support on which it may be run back and forth. The last device is useful in accustoming birds to feed nearer and nearer a comfortable observation point. A fault with food shelves is that wind and rain may sweep them clean and snow may cover the food. These defects may be obviated in part by adding a raised ledge about the margin or by placing the shelf in the shelter of a wall or shielding it with evergreen branches on one or more sides.

Feeding devices not affected by the weather are preferable. An excellent one is a coconut with a hole bored in one end. (Fig. 7.) The cavity is filled with chopped suet and nuts or other food mixture, and the nut is suspended by a wire from a limb. The size of the hole regulates the character of the guests; if small, large birds can not gobble the supply, and the coconut meat as well as the stuffing is eaten. Cans with small openings may be substituted for coconuts. Food baskets of any desired size made of wire netting or a metal grating may be hung up or fastened to the trunk of a tree. Food mixtures in melted fat may be poured into holes made in a branch or piece of timber (fig. 8) or in cracks of bark or over evergreen branches. All of these devices minimize or obviate the disturbing effects of stormy weather.

FIG. 5.—Food tray.

More elaborate apparatus for the same purpose comprises various forms of food hoppers and food houses. The food hoppers (fig. 9) in common use for domestic fowls are adapted to the feeding of birds, and some special forms are now manufactured for wild birds.

FIG. 6.—Food shelf.

The food house is a permanent structure, with solid roof, and glass on one or more sides to permit observations. (Fig. 10.) The food trays it contains are entirely sheltered from the weather. In one style this result is obtained by mounting the house on a pivot and furnishing it with vanes (fig. 11) which keep the open side always away from the wind.

Game birds and sparrows may be provided with feeding places by erecting low hutches or making wigwamlike shocks of corn or grain sheaves under which food may be scattered. The opening should be to the south.

Those who desire to have birds about their homes should not feel that their power to attract them is gone when winter is over. Winter feeding easily passes into summer feeding, and experience proves that some birds gladly avail themselves throughout the year of this easy mode of getting a living.


FIG. 7.—Coconut larder.

NATURAL FOOD SUPPLY.

We have thus far considered ways of feeding birds tidbits we ourselves have gleaned. We may feed them by another method, by cultivating their natural food plants and allowing them to reap the harvest in their own way.

Less has been done in this respect for the true seed-eating birds than for those fond of pulpy fruits. The reason is obvious, however. Our seed-eating birds largely patronize weeds, which we do not wish to cultivate, while the fruit eaters depend upon many plants which we hold in such esteem for their ornamental value that they are generally cultivated.

FEEDING SEED-EATING BIRDS.

Something can be done to attract the seed eaters about our homes, however. A number of commonly cultivated annual plants, belong-

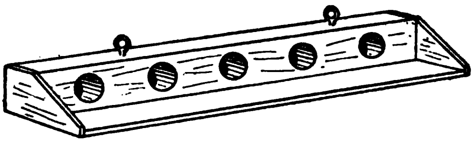


FIG. 8.—Feeding stick.

ing to the same groups as those upon which the birds feed extensively in nature, produce good crops of seeds. These plants, being dependent upon cultivation, can be used without fear that they will become pests. The following are suggested for the purpose: Prince's feather (*Amaranthus cruentus*), love lies bleeding (*A. caudatus*), asters, calandrinias, blessed thistle (*Carduus benedictus*), centaureas, California poppies (*Eschscholtzia*), sunflowers, tarweed (*Madia elegans*), forget-me-nots, *Polygonum orientale* and *P. sachalinense*, *Portulaca*, *Silene*, and sugar cane (sorghum varieties).

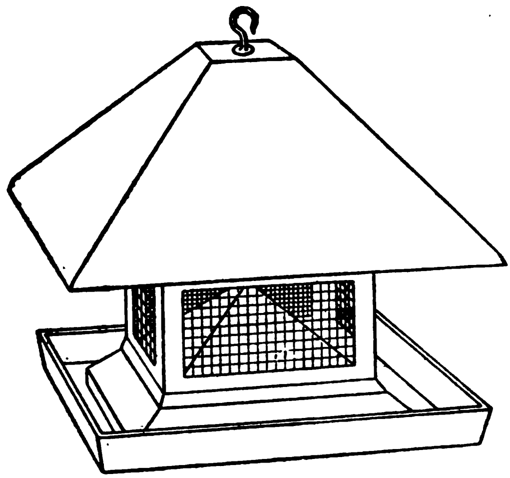


Fig. 9.—Food hopper (roof detachable).

The various millets are relished by nearly all seed-eating birds. Common millet (*Panicum miliaceum*), Japanese millet or barnyard grass (*Echinochloa crus-galli*), and German millet or Hungarian grass (*Setaria italica*) are for sale by most seedsmen, and should be planted in abundance by those wishing to attract granivorous birds. The height and stiffness of stalk of varieties of sorghum should make these abundant seeders valuable in winter. Japanese millet holds its seeds well, and, if planted thickly where it can grow up through a horizontal lattice work, makes a valuable cover and feeding place for winter birds. Canary grass (*Phalaris canariensis*) and various species of *Pennisetum* also are good for seed-eating birds.

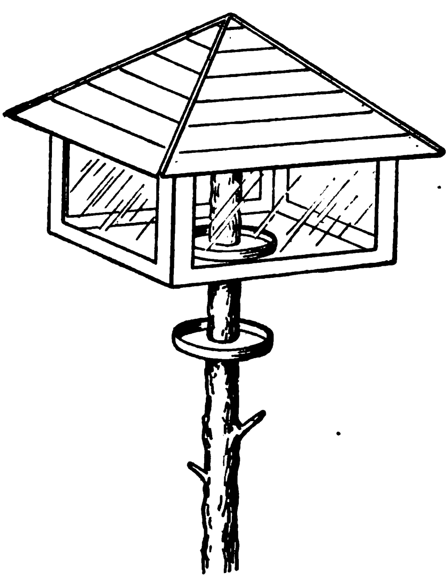


Fig. 10.—Food house.

Alders and birches bear in their numerous cones a supply of seeds which are eagerly sought for by redpolls, siskins, and goldfinches during the winter. We can cater to still another group of birds by planting ashes and box elders. The winged fruits of these trees are opened and the seeds eaten by pine and evening grosbeaks, the visits of these birds being largely regulated by the supply of this kind of food. Larches, pines, and other conifers are attractive to crossbills as well as to some of the species just mentioned.

FEEDING FRUIT-EATING BIRDS.

Feeding fruit-eating birds is best accomplished by planting selected species of fruit-bearing shrubs and trees. The species listed in Table 1 are selected from a much larger number which are known to be favorites with fruit-eating birds. Various considerations have influenced choice, as ornamental value, earliness, lateness, or length of fruiting season, and especially availability of the plants through ordinary channels of trade. The data on fruiting season have been compiled from the principal herbaria of New York and New England, with a few additions from other sources. Alfred Rehder and other members of the staff of the Arnold Arboretum, and C. C. Laney, of the Rochester Board of Park Commissioners, have made valuable suggestions concerning the list.

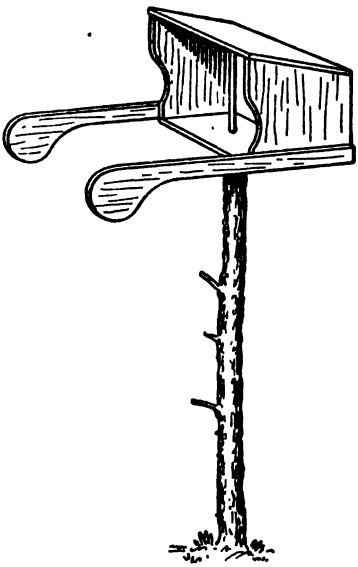


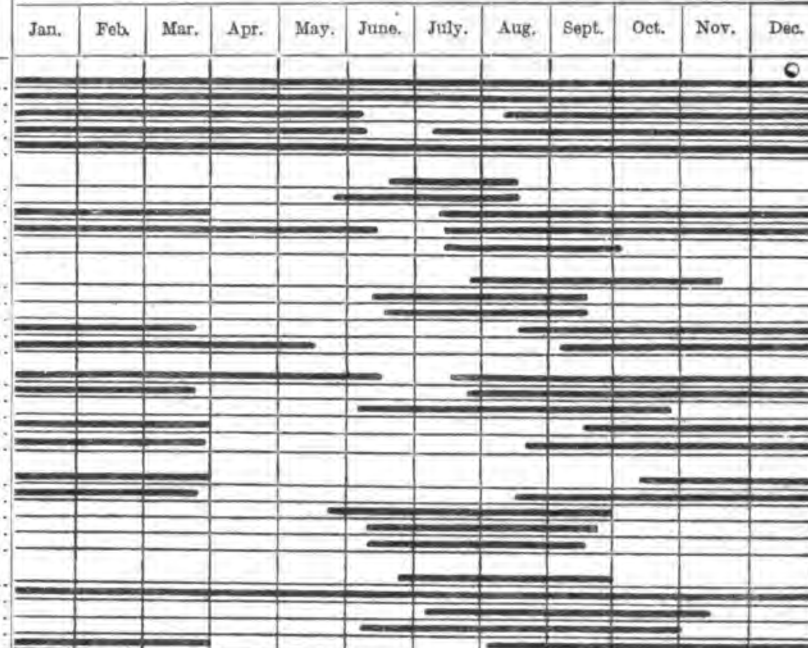
FIG. 11.—Food house on pivot.

The fruiting seasons indicated include the earliest and latest dates recorded for New York and New England. Hence it can not be expected that fruit will be available in any one locality throughout the entire bearing season of a plant, unless a large number are set out and in a variety of situations. Purchasers may obtain information from nursery catalogues as to where, when, and how to plant. Notes on species which may be substituted for some of those in the main list, and other comments, follow the table.

TABLE 1.—*Seasons of fruits attractive to birds.*

Common name.	Scientific name.	Native or introduced.
Juniper	*Juniperus communis*	Native
Red cedar	*Juniperus virginiana*	do
Green brier	*Smilax rotundifolia*	do
Bayberry	*Myrica carolinensis*	do
Hackberry	*Celtis occidentalis*	do
Red mulberry	*Morus rubra*	do
White mulberry	*Morus alba*	Introduced
Pokeweed	*Phytolacca decandra*	Native
Barberry	*Berberis vulgaris*	Introduced
Sassafras	*Sassafras variifolium*	Native
Spice bush	*Benzoin aestivale*	do
Wild gooseberry	*Ribes cynosbati*	do
Red currant	*Ribes vulgare*	Introduced
Asiatic currant [1]	*Ribes fasciculatum*	do
Flowering crab apple	*Pyrus floribunda*	do
Chokeberry	*Pyrus melanocarpa*	Native
Mountain ash	*Pyrus americana*	do
Juneberry	*Amelanchier canadensis*	do
Asiatic service-tree [2]	*Amelanchier asiatica*	Introduced
Cockspur thorn	*Crataegus crus-galli*	Native
Washington thorn	*Crataegus phaenopyrum*	Introduced
English thorn	*Crataegus oxyacantha*	do
Wild strawberry	*Fragaria americana*	Native
Wild blackberry	*Rubus allegheniensis*	do
Wild blackberry	*Rubus triflorus*	do
Wild blackberry	*Rubus canadensis*	do
Pasture rose [1]	*Rosa humilis*	do
Wild black cherry	*Prunus serotina*	do
Wild red cherry	*Prunus pennsylvanica*	do
Beach plum [1]	*Prunus maritima*	do

Fruiting season.

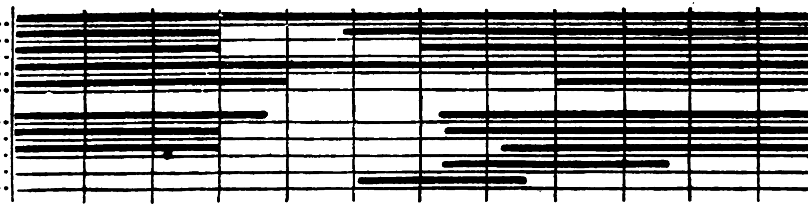


[1] Fruit becoming dry at end of season.
[2] Apparently procurable only from foreign dealers.

TABLE 1.—*Seasons of fruits attractive to birds*—Continued.

Common name.	Scientific name.	Native or introduced.	Fruiting season.											
			Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Sand cherry	*Prunus pumila*	Native												
Crowberry	*Empetrum nigrum*	do												
Smooth sumac	*Rhus glabra*	do												
Fragrant sumac	*Rhus aromatica*	do												
Holly [1]	*Ilex opaca*	do												
Inkberry [1]	*Ilex glabra*	do												
Black alder [1]	*Ilex verticillata*	do												
Mountain holly [1]	*Nemopanthus mucronata*	do												
Bittersweet	*Celastrus scandens*	do												
Buckthorn	*Rhamnus cathartica*	Introduced												
Virginia creeper	*Psedera quinquefolia*	Native												
Japanese creeper [2]	*Ampelopsis t. icuspidata*	Introduced												
Summer grape [2]	*Vitis aestivalis*	Native												
Frost grape	*Vitis vulpina*	do												
Leatherwood	*Dirca palustris*	do												
Wild pepper	*Daphne mezereum*	Introduced												
Oleaster [2]	*Elaeagnus angustifolia*	do												
Buffalo berry	*Shepherdia canadensis*	Native												
Wild sarsaparilla	*Aralia nudicaulis*	do												
Asiatic sarsaparilla [2]	*Acanthopanax sessiliflorum*	Introduced												
Bunchberry	*Cornus canadensis*	Native												
Flowering dogwood	*Cornus florida*	do												
Red osier [2]	*Cornus stolonifera*	do												
Alternate-leaved dogwood	*Cornus alternifolia*	do												
Sour gum	*Nyssa sylvatica*	do												
Wintergreen	*Gaultheria procumbens*	do												
Bearberry	*Arctostaphylos uva-ursi*	do												
Creeping snowberry	*Chiogenes hispidulus*	do												
Black huckleberry	*Gaylussacia baccata*	do												
Early sweet blueberry	*Vaccinium pennsylvanicum*	do												
Swamp blueberry	*Vaccinium corymbosum*	do												
Cranberry	*Vaccinium macrocarpon*	do												
Persimmon [1]	*Diospyros virginiana*	do												
Privet	*Ligustrum vulgare*	Introduced												
Purple berry	*Callicarpa purpurea*	do												

Partridge berry	*Mitchella repens*	Native
Fly honeysuckle [2]	*Lonicera caerulea*	do
Tartarian honeysuckle [2]	*Lonicera tatarica*	Introduced
Snowberry	*Symphoricarpos racemosus*	Native
Coralberry	*Symphoricarpos vulgaris*	do
High-bush cranberry	*Viburnum opulus*	do
Arrowwood	*Viburnum acerifolium*	do
Sheepberry	*Viburnum lentago*	do
Common elder	*Sambucus canadensis*	do
Red-berried elder	*Sambucus racemosa*	do



[1] Sexes tending to be on separate plants; both required.
[2] Fruit becoming dry at end of season.

Notes on the foregoing list.

Bayberry. Usual trade name is *Myrica cerifera.*

Hackberry. Fruit scarce in late May and June. *Celtis serrata, C. bungeana,* or *C. mississippiensis* may be substituted.

Mulberry. *Morus tatarica* may be used.

Pokeweed. Let it grow through shrubs or a trellis which will support it in winter.

Barberry. *Berberis amurensis, B. aristata, B. regeliana,* and *B. rehderiana* are good substitutes. The universally planted *B. thunbergi* seems to be of very little value as bird food.

Sassafras. Appears in most catalogs as *S. officinale* or *S. sassafras.*

Flowering apple. The following may be substituted: *P. baccata, P. halliana, P. parkmanni, P. sargentii,* and *P. toringo.*

Chokeberry. Often called *Pyrus* or *Aronia nigra. P. arbutifolia,* another native species, retains its fruit just as long, but the fruit becomes very dry toward the end of the season.

Cherry. *Prunus cerasifera, P. fruticosus, P. japonica pendula, P. sargentii,* and *P. tomentosa,* all introduced, are worth adding.

Sumac. *Rhus copallina* or *R. hirta* (*typhina*) may be substituted for *R. glabra.*

Juneberry. *Amelanchier canadensis,* sold by nurserymen, is a composite species. Several species are now recognized, among which *A. laevis* is a notably early fruiter and *A. sanguinea* a late one. Some fruit of juneberries occasionally hangs much later than the season indicated, but in very dry condition.

Thorns. The species recommended are those usual in the trade. So far as desirability is concerned many native species could be substituted. Cotoneasters, such as *C. coccinea, C. horizontalis, C. microphylla, C. rotundifolia,* and *C. tomentosa,* may also be used.

Strawberry. Often called *Fragaria vesca* var. *americana. F. virginiana* is a fair substitute. Little dealt in; must usually be transplanted from woods and fields.

Blackberry. *Rubus triflorus* is frequently called *R. americanus.*

Rose. All native species have persistent fruit. The small-fruited ones are best for birds. *Rosa carolina* and *R. nitida* are suitable for low grounds; and *R. humilis* (sometimes called *virginiana*) and *R. setigera* may be planted in drier places. *R. micrantha* and *R. multiflora* are among the best introduced roses.

Black alder. *Ilex laevigata* may be used instead of *I. verticillata. I. serrata* is a good introduced species.

Mountain holly. Drops most of its berries in the fall; only a few persist throughout the season indicated.

Bittersweet. *Celastrus orbiculatus,* introduced, may be used.

Buckthorn. *Rhamnus dahurica* is equally good.

Virginia creeper. Often sold under the names *Ampelopsis* and *Parthenocissus. A. heterophylla* and *P. vitacea* may be substituted.

Wild pepper. *Hippophaë rhamnoides* may replace it, especially along coast.

Oleaster. *Elaeagnus longipes, E. multiflora, E. parviflora,* and *E. umbellata* also are good.

Buffalo berry. *Shepherdia* (*Lepargyrea*) *argentea,* the true buffalo berry, furnishes good bird food.

Dogwood. *Cornus paniculata* (*candidissima*), native, and *C. alba* and *C. sanguinea,* introduced, are worthy substitutes.

Huckleberry. *Gaylussacia baccata* is often sold as *G. resinosa.*

Blueberry. Any species may be substituted.
Cranberry. Generic name often given as *Oxycoccus*.
Privet. *Ligustrum acuminatum*, *L. amurense*, *L. ciliatum*, *L. ibota*, and *L. microcarpum*, all introduced, are equally good. Must not be clipped; berries borne on outer twigs.
Purpleberry. Variety *japonica* is the hardy form.
Honeysuckle. *Lonicera glauca*, *L. canadensis*, *L. oblongifolia*, and *L. sempervirens*, native, and *L. maackii*, introduced, may be substituted.
Snowberry. *Symphoricarpus occidentalis* is just as good.
Virburnum. *V. dentatum*, native, and *V. sieboldii*, introduced, are worth adding.
Elder. *Sambucus nigra*, introduced, also is valuable.

PROTECTING CULTIVATED FRUITS.

Birds devour cultivated fruit principally because the processes of cultivation diminish the wild supply. The presence of wild fruit in a locality always serves to protect domestic varieties, especially when the wild trees or shrubs are of the same kind as the cultivated ones and ripen earlier.

Table 2 shows in a graphic way the species which may be used to protect the principal classes of cultivated fruits.

TABLE 2.—*Seasons of fruits useful to protect cultivated varieties.*

Common name.	Scientific name.	Native or introduced.	To protect—	Fruiting season. May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Wild strawberry	*Fragaria americana*	Native	Strawberries								
Baked-apple berry	*Rubus chamaemorus*	do	Raspberries and blackberries.								
Wild blackberry	*Rubus canadensis*	do	do								
Wild blackberry	*Rubus allegheniensis*	do	do								
Wild blackberry	*Rubus triflorus*	do	do								
Wild blackberry	*Rubus frondosus*	do	do								
Wild pepper	*Daphne mezereum*	Introduced	do								
Red mulberry	*Morus rubra*	Native	Cherries								
White mulberry	*Morus alba*	Introduced	do								
Juneberry	*Amelanchier canadensis*	Native	do								
Wild red cherry	*Prunus pennsylvanica*	do	do								
Japanese cherry	*Prunus japonica pendula*	Introduced	do								
Sargent cherry [1]	*Prunus sargentii*	do	do								
Mahaleb cherry	*Prunus mahaleb*	do	do								
Fly honeysuckle	*Lonicera canadensis*	Native	do								
Fly honeysuckle	*Lonicera caerulea*	do	do								
Red berried elder	*Sambucus racemosa*	do	do								
Asiatic service-tree [1]	*Amelanchier asiatica*	Introduced	Apples and pears								
Silky-leaved pear [1]	*Pyrus elaeagrifolium*	do	do								
Flowering crabapple	*Pyrus floribunda*	do	do								
Dwarf crabapple	*Pyrus toringo*	do	do								
Hybrid crabapple [1]	*Pyrus prunifolia*	do	do								
Cockspur thorn	*Crataegus crus-galli*	Native	do								
English thorn	*Crataegus oxyacantha*	Introduced	do								
One-seeded thorn	*Crataegus monogyna*	do	do								

[1] Apparently procurable only from foreign dealers.

PLANTS FOR THE SHORE.

Where the coast is rocky and the soil of ordinary character, conditions are little different from those inland, and except in relation to exposure there need be no especial preference given in the choice of plants. It is worth mentioning, however, that several trees and shrubs are better adapted to withstand the winds so prevalent on the coast. These include three species of juniper (*Juniperus communis*, *J. horizontalis*, and *J. virginiana*), common barberry, English thorn, hybrid crabapple, European and American mountain ashes, smooth and staghorn sumacs, privets, buckthorn, and red-berried elder. Where the soil is chiefly sand, and that often shifting, conditions are not suited to many plants. Selection may be made, however, from the following, all of which are known to thrive in such surroundings:

For seed eaters.—Beach grass (*Ammophila arenaria* and *Calamovilfa longifolia*), *Polygonum sachalinense*, and sunflower.

For fruit eaters.—Bayberry (*Myrica cerifera*), sea buckthorn (*Hippophaë rhamnoides*), sand cherry (*Prunus pumila* or *P. cuneata*), beach plum (*Prunus maritima*), cranberries, and bearberry (*Arctostaphylos uva-ursi*).

[The Biological Survey will be pleased to receive information supplementary to that here given regarding any plants that actual trial has shown to be valuable as bird food, and their fruiting seasons.]

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1914

U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 621

HOW TO ATTRACT BIRDS

IN NORTHEASTERN UNITED STATES

BIRDS appeal strongly to the interests and affections of mankind. Not only do they charm by their neat forms, harmonious colors, sprightly actions, and usually pleasing notes, but they have an even more important claim upon our esteem because of their great economic value.

Birds feed upon practically all insect pests. They are voracious, able to move freely from place to place, and exert a steady influence in keeping down the swelling tide of insect life.

For economic as well as for esthetic reasons, therefore, an effort should be made to attract and protect birds and to increase their numbers. Where proper measures of this kind have been taken an increase of several fold in the bird population has resulted, with decreased losses from depredations of injurious insects.

This bulletin is one of a series intended to describe the best methods of attracting birds in various parts of the United States, especially by providing a food supply and other accessories about the homestead. The area to which it is adapted is shown by the map on page 1.

Washington, D. C.

Issued December 14, 1914
Revised August, 1931

HOW TO ATTRACT BIRDS IN NORTHEASTERN UNITED STATES

By W. L. McAtee, *Principal Biologist, in Charge Division of Food Habits Research, Bureau of Biological Survey*

CONTENTS

THE means of increasing the number of birds about the home are few and simple. They comprise adequate protection and the provision of suitable nesting places, food, and water. The Bureau of Biological Survey is preparing a series of publications, of which this bulletin relating to northeastern United States (fig. 1) is one,[1] to recommend practicable methods of attracting birds about homes in the various parts of the United States. Especial attention will be given to the value of fruit-bearing shrubs and trees, as less information relating to these as a means of attracting birds is available than concerning more widely known but not more important measures like protection, winter feeding, and the supplying of nesting boxes and water. Furthermore, the last-named measures need not vary so much with the locality as does choice of fruit-bearing shrubs and trees.

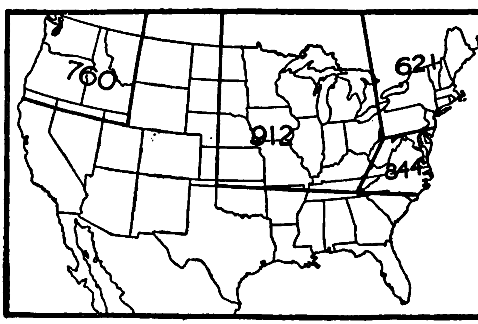


FIGURE 1.—Map of the United States, the area containing the number of this bulletin, 621, showing the territory to which this publication applies. Similar bulletins have been prepared for other sections, as indicated by the numbers

PROTECTION

Protection is the prime requisite for increasing the number of birds in any area, and the results of protection are in direct proportion to its thoroughness. Besides being insured against every form of persecution by human kind, birds must be defended from various

[1] Other bulletins in the series now available are Farmers' Bulletin 760, relating to the Northwestern States; 844, to the Middle Atlantic States; 912, to the East Central States; and (for general distribution) 1456, on Homes for Birds, and 1644, on Local Bird Refuges.

natural foes. The most effectual single step is to surround the proposed bird sanctuary with a vermin-proof fence. (Fig. 2.) Such a fence should prevent entrance either by digging or by climbing, but will serve its greatest use if it can not be climbed, and is therefore cat proof.[2] For this purpose the erect part of the fence aboveground

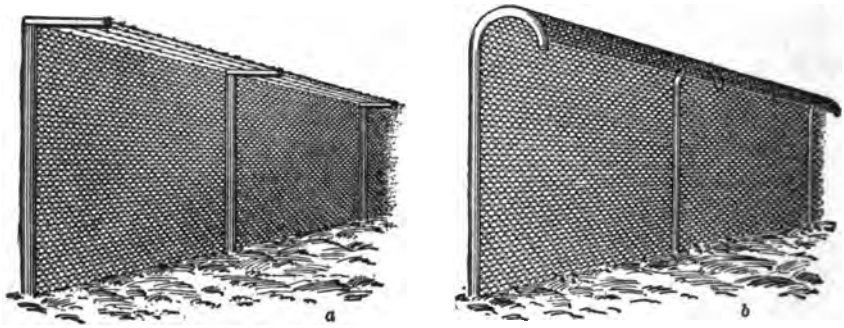


FIGURE 2.—Cat-proof fence: *a*, With barbed wire; *b*, with loose overhanging netting

should be 6 feet high, and the weave should not be more than 1½-inch mesh. The overhang should be 2 feet wide, and if strung with wires these should be not more than 1½ inches apart. If it is impracticable to build an impenetrable fence, the next best device is to put guards (fig. 3) of sheet metal on all nesting trees and on poles supporting bird houses. This should be done in any case where squirrels or snakes are likely to intrude, as it is usually impossible to fence out these animals. Tree guards should be 6 feet or more above ground. Attacks by hawks, owls, crows, jays, or other enemies are best controlled by eliminating the destructive individuals. Those who wish to combat English sparrows will find full directions for so doing in Leaflet 61, English Sparrow Control.

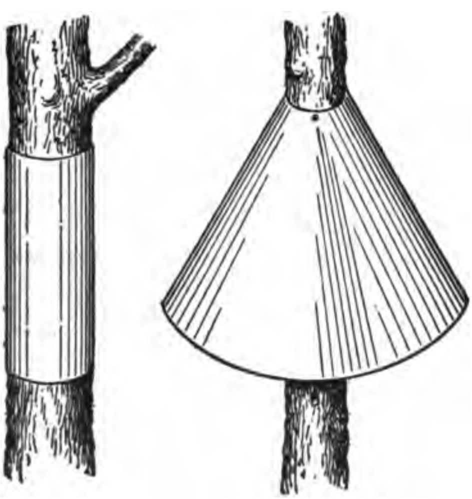


FIGURE 3.—Tree guards

BREEDING PLACES

Although a considerable number of our native birds build their nests on the ground, the majority place them in trees or shrubs, either in holes or on the limbs or in the crotches. Shrubbery and trees for nesting sites, therefore, are essential for making a place attractive to birds, and a double purpose is served if the kinds planted are chosen from the list of fruit-bearing species given further on. Shrubs should

[2] Fuller information on vermin-proof fencing may be obtained from Farmers' Bulletin 1613, Propagation of Upland Game Birds.

be allowed to form thickets and should be pruned back severely when young so as to produce numerous crotches.

Modern tree surgery and constant removal of old trees have resulted in a great dimunition in the number of tree cavities, the natural homes of most of our hole-nesting birds. Fortunately, most of these birds will utilize artificial nest cavities or bird houses. All truly interested in the welfare of birds will see that plenty of bird boxes are available; it is better to do this than to lament the passing of our interesting hole-dwelling species. The sizes useful for various birds, plans for making, and illustrations of numerous bird boxes are given in Farmers' Bulletin 1456, Homes for Birds. Styles of bird houses may be almost endlessly varied. These structures may be improvised by anyone, but they may be purchased also from numerous dealers. A bird house needs only partial shade, and houses on poles usually are taken. Martins prefer a house standing apart from trees. These are our only birds occupying colony houses; homes for other birds should have one room only. Entrances to boxes should be sheltered by projecting roofs, and should face away from the prevailing wind and rainstorms.

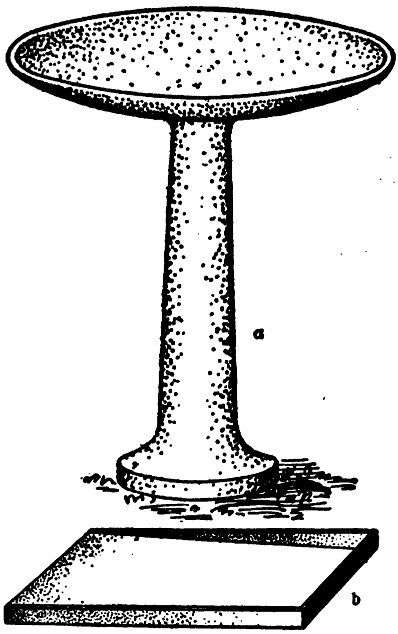


FIGURE 4.—Bird baths: a, Pottery; b, metal or concrete

All bird houses should be constructed so that the interior may easily be examined and cleaned. This is not only important to permit last year's rubbish to be thrown out, but is necessary in much of the area for which the present bulletin is written to facilitate inspection for gipsy-moth egg masses and cocoons.

It is best to clean out bird houses after every brood; this not only invites reoccupation of the box but rids it of parasites. To destroy thoroughly the latter, application of a strong disinfectant is required. Birds as a rule not only do not want bird neighbors too near, but they are impatient of human meddling, and therefore should be granted as much privacy as possible during the actual incubating and brooding. Nests built in shrubbery are especially likely to come to a bad end if the birds are frequently disturbed.

If ground-nesting birds, as bobolinks, meadowlarks, and bobwhites, are to be protected, grass in the nesting fields must not be cut during the breeding season.

WATER SUPPLY

Nothing has a more potent attraction for birds during hot weather than drinking and bathing places. The birds' water supply should be a pool not more than a few inches deep, the bottom sloping gradually upward toward the edge. Both bottom and edge should be rough, so as to afford a safe footing. A giant pottery saucer (fig. 4, *a*) is an excellent device, or the pool may be made of concrete or even metal, if the surface be roughened or covered with gravel (fig. 4, *b*). The bird bath may be elevated, or it may be on the ground if in an open space where skulking enemies can not approach too near.

A water supply is appreciated in winter as well as in summer. If running water can not be provided, that supplied should be warmed to delay freezing, and renewed at least daily.

FIGURE 5.—Food tray

FIGURE 6.—Food shelf

FOOD SUPPLY

Food supply is the vital factor in bird life and the most important single offering that can be made in efforts to attract birds. It is worth noting that an ample supply of food prior to and during the nesting season tends to increase the number of eggs laid and also the number of broods in a season. Insects and their larvae are the principal food of many of our birds, and these usually are sufficiently numerous. On game-bird farms, dense growths of vegetation are especially developed for the sake of the insects they will produce to feed the young birds. Aside from insects, bird food may be supplied in two ways—by planting trees, shrubs, and herbs which produce seeds or fruits relished by birds, and by exposing food in artificial devices. The most familiar phase of the latter method is winter feeding.

ARTIFICIAL FOOD

During the season when the natural food supply is at its lowest ebb birds respond most readily to our hospitality. Winter feeding has become very popular, and the result has been to bring about better understanding between birds and human kind.

The winter foods commonly used include suet or other fat, pork rinds, bones with shreds of meat, cooked meats, meal worms, cut-up apples, birdseed, buckwheat, crackers, crumbs, coconut meat, cracked corn, broken dog biscuits or other bread, hempseed, millet, nut meats of all kinds (especially peanuts), whole or rolled oats, peppers, pop corn, pumpkin or squash seeds, raw or boiled rice, sunflower seeds, and wheat.

FIGURE 7.—Coconut larder

The methods of making these supplies available to birds are as varied as the dietary itself. A device very commonly used is the food tray or shelf. (Figs. 5 and 6.) This may be put on a tree or pole, by a window or at some other point about a building, or strung upon a wire or other support on which it may be run back and forth. The last device is useful in accustoming birds to feed nearer and nearer a comfortable observation point. A fault with food shelves is that wind and rain may sweep them clean and snow may cover the food. These defects may be obviated in part by adding a raised ledge about the margin or by placing the shelf in the shelter of a wall or shielding it with evergreen branches on one or more sides.

Feeding devices not affected by the weather are preferable. An excellent one is a coconut with a hole cut in one end. (Fig. 7.) The cavity is filled with chopped suet and nuts or other food mixture, and the nut is suspended by a wire from a limb. The size of the hole regulates the character of the guests; if small, large birds can not gobble the supply. The coconut meat as well as the stuffing is eaten.

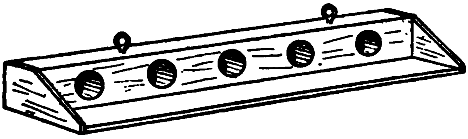


FIGURE 8.—Feeding stick

Cans with small openings may be substituted for coconuts. Food baskets of any desired size made of wire netting or a metal grating may be hung up or fastened to the trunk of a tree. Food mixtures in melted fat may be poured into holes made in a branch or stick (fig. 8) or in cracks of bark or over evergreen branches. All of these devices minimize or obviate the disturbing effects of stormy weather.

More elaborate apparatus for the same purpose comprises various forms of food hoppers and food houses. The food hoppers (figs. 6

and 9) in common use for domestic fowls are adapted to the feeding of birds, and some special forms are now manufactured for wild birds.

The food house is a permanent structure, with solid roof, and glass on one or more sides to permit observations. (Fig. 10.) The food trays it contains are entirely sheltered from the weather. In one style this result is obtained by mounting the house on a pivot and furnishing it with vanes (fig. 11) which if large enough keep the open side always from the wind.

Game birds and sparrows may be provided with feeding places[3] by erecting low hutches or making wigwamlike shocks of corn or grain sheaves under which food may be scattered. The opening should be to the south.

Those who desire to have birds about their homes should not feel that their power to attract them is gone when winter is over. Winter feeding easily passes into summer feeding, and experience proves that some birds gladly avail themselves throughout the year of this easy mode of getting a living.

NATURAL FOOD

Ways of feeding birds tidbits which we have gleaned have been considered. They may be fed by another method, by cultivating their natural food plants and allowing them to reap the harvest in their own way.[4]

Less has been done in this respect for the true seed-eating birds than for those fond of pulpy fruits. The reason is obvious, however. Our seed-eating birds largely patronize weeds, which we do not wish to cultivate, while the fruit eaters depend upon many plants which are held in such esteem for their ornamental value that they are generally cultivated.

FEEDING SEED-EATING BIRDS

Something can be done, however, to attract the seed eaters about our homes. A number of commonly cultivated annual plants, belonging to the same groups as those upon which the birds feed extensively in nature, produce good crops of seeds. These plants, being dependent upon cultivation, can be used without fear that they will become pests. The following are suggested for the purpose: Princes-feather (*Amaranthus cruentus*), love lies bleeding (*A. caudatus*), asters, calandrinias, blessed thistle (*Carduus benedictus*), centaureas, California poppies (Eschscholtzia), sunflowers, tarweed (*Madia elegans*), forget-me-nots, *Polygonum orientale* and *P. sashalinense*, Portulaca, Silene, and sugarcane (sorghum varieties).

The various millets are relished by nearly all seed-eating birds. Common millet (*Panicum miliaceum*), Japanese millet or barnyard grass (*Echinochloa crus-galli*), and German millet or Hungarian grass (*Setaria italica*) may be obtained from most seedsmen, and

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[3] See also Biological Survey mimeographed Leaflet Bi–1099, Winter Feeding of Upland Game Birds; copies will be furnished by the Bureau of Biological Survey on request.

[4] The Bureau of Biological Survey will be pleased to receive information supplementary to that given in this bulletin regarding any plants shown by actual trial to be valuable as bird food, and their fruiting seasons.

should be planted in abundance by those wishing to attract granivorous birds. The height and stiffness of stalk of varieties of sorghum should make these abundant seeders valuable in winter. Japanese millet holds its seeds well and, if planted thickly where it can grow up through a horizontal lattice work, makes a valuable cover and feeding place for winter birds. Canary grass (*Phalaris canariensis*) and various species of Pennisetum also are good for seed-eating birds.

Alders and birches bear in their numerous cones a supply of seeds which are eagerly sought for by redpolls, siskins, and goldfinches during the winter. Still another group of birds may be catered to by planting ashes and box-elders. The winged fruits of these trees are opened and the seeds eaten by pine and evening grosbeaks, the visits of these birds being largely regulated by the supply of this kind of food. Larches, pines, and other conifers are attractive to crossbills as well as to some of the species just mentioned.

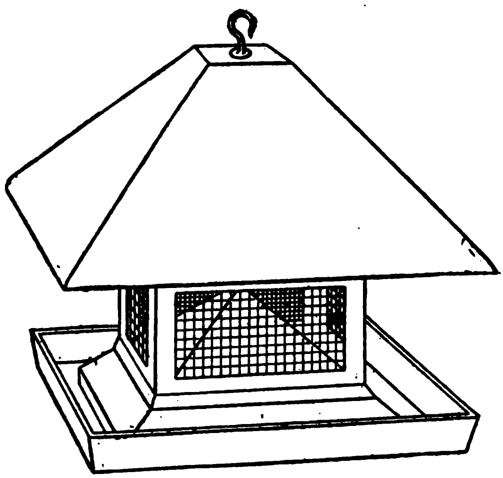


FIGURE 9.—Food hopper (roof detachable)

FEEDING FRUIT-EATING BIRDS

Feeding fruit-eating birds is best accomplished by planting selected species of fruit-bearing shrubs and trees. Through late spring and summer there is usually an abundance of insect food in addition to fruit enough for all the birds. So far as fruit alone is concerned, fall is the season of overflowing abundance; in winter the supply gradually decreases, and late winter and early spring are the seasons of actual scarcity. This is the critical time of year for many birds, and a plentiful supply of wild fruit will tide them over. Fortunately, everywhere in the United States there are some fruits that persist until there is no longer any need for them. If enough are planted, no birds able to live on this class of food should starve. The best of these long persisting fruits are juniper, bayberry, thorn apples and related fruits, holly, and snowberry.

How cultivation of ornamental shrubs and trees can greatly increase the winter supply of fruit in the area covered by this bulletin is convincingly shown by the subjoined lists. That (Table 1) made in the vicinity of Boston, Mass., but chiefly in the Arnold Arboretum, reveals that 135 species were holding their fruit to the middle of March, while another count (Table 2) made in a smaller plantation in New York City about a week earlier shows 56 species, 35 of them additional to the Boston list.

TABLE 1.—*Persistent fruits in the vicinity of Boston, Mass., chiefly in the Arnold Arboretum, Jamaica Plains, March 13–21, 1914*

Common name	Scientific name
Common juniper	*Juniperus communis.*
Red cedar	*Juniperus virginiana.*
Bristly greenbrier	*Smilax hispida.*
Hackberry	*Celtis bungeana.*
Do	*Celtis mississippiensis.*
Do	*Celtis occidentalis.*
Do	*Celtis serrata.*
Common pokeberry	*Phytolacca americana.*
Amur barberry	*Berberis amurense.*
Allegheny barberry	*Berberis canadensis.*
Kansu barberry	*Berberis diaphana.*
Guimpel's barberry	*Berberis guimpeli.*
Siebold's barberry	*Berberis sieboldii.*
Chinese barberry	*Berberis sinensis.*
Japanese barberry	*Berberis thunbergi.*
European barberry	*Berberis vulgaris.*
Common moonseed	*Menispermum canadense.*
Asiatic moonseed	*Menispermum dauricum.*
Winter currant	*Ribes fasciculatum.*
Firethorn	*Cotoneaster horizontalis.*
Do	*Cotoneaster lucida.*
Do	*Cotoneaster tomentosa.*
Do	*Cotoneaster vulgaris.*
Hawthorn	*Crataegus armata.*
Canby's hawthorn	*Crataegus canbyi.*
Carriere's hawthorn	*Crataegus carrierei.*
Chapman's hawthorn	*Crataegus chapmani.*
Coral hawthorn	*Crataegus colorado.*
Washington hawthorn	*Crataegus cordata.*
Hawthorn	*Crataegus corporea.*
Cockspur thorn	*Crataegus crus-galli.*
Dawson hawthorn	*Crataegus dawsoniana.*
Hawthorn	*Crataegus densiflora.*
Do	*Crataegus ferentaria.*
Do	*Crataegus flabellata.*
Do	*Crataegus gemmosa.*
Illinois hawthorn	*Crataegus illinoensis.*
Hawthorn	*Crataegus irrasa.*
Do	*Crataegus macrantha.*
Do	*Crataegus monogyna.*
Do	*Crataegus neapolitana.*
Do	*Crataegus nitida.*
Do	*Crataegus oxyacantha.*
Do	*Crataegus oxyacanthoides.*
Do	*Crataegus persistens.*
Do	*Crataegus pinnatifida.*
Do	*Crataegus pruinosa.*
Do	*Crataegus rotundifolia.*
Do	*Crataegus rupicola.*
Do	*Crataegus tomentosa.*
Do	*Crataegus viridis.*
Laurel hawthorn	*Photinia villosa.*
Arnold crab apple	*Malus arnoldiana.*
Siberian crab apple	*Malus baccata and var. oblonga.*
Wild sweet crab apple	*Malus dawsoniana.*
Japanese flowering crab apple	*Malus floribunda.*
Hall crab apple	*Malus halliana.*
Kaido crab apple	*Malus kaido.*
Pearleaf crab apple	*Malus prunifolia (rubra cerasiforme).*
Sargent crab apple	*Malus sargenti.*
Scheidecker crab apple	*Malus scheideckeri.*
Toringo crab apple	*Malus seiboldi.*
Chinese flowering crab apple	*Malus spectabilis.*
American mountain-ash	*Sorbus americana.*
Japan mountain-ash	*Sorbus matsumurana.*
Birchleaf pear	*Pyrus betulaefolia.*
Service berry	*Amelanchier canadensis.*
Do	*Amelanchier oblongifolia.*
Do	*Amelanchier spicata.*
Black chokeberry	*Aronia malanocarpa.*
Rose	*Rosa alberti.*
Rose	*Rosa arvensis.*
Do	*Rosa blanda.*
Do	*Rosa canina dumetorum.*
Do	*Rosa coriifolia.*
Do	*Rosa gaiana.*
Do	*Rosa hibernica.*
Do	*Rosa kamskatica.*
Do	*Rosa multiflora.*
Do	*Rosa palustris.*
Do	*Rosa rubiginosa.*
Do	*Rosa rugosa.*
Do	*Rosa setigera.*
Do	*Rosa spinosissima.*
Sakhalin corktree	*Phellodendron sachalinense.*
Smooth sumac	*Rhus glabra.*
Staghorn sumac	*Rhus hirta.*
Poison ivy	*Toxicodendron radicans.*
Inkberry	*Ilex glabra.*
Smooth winterberry	*Ilex laevigata.*
American holly	*Ilex opaca.*
Common winterberry	*Ilex verticillata.*
Mountain-holly	*Nemopanthus mucronatus.*
Burningbush	*Euonymus bungeanus.*
Wintercreeper	*Euonymus radicans vegetus.*
Oriental bittersweet	*Celastrus orbiculatus.*
American bittersweet	*Celastrus scandens.*
Japanese pachysandra	*Pachysandra terminalis.*
Common buckthorn	*Rhamnus cathartica.*
Japanese buckthorn	*Rhamnus crenata.*
Dahurian buckthorn	*Rhamnus dahurica.*
Japanese creeper	*Ampelopsis tricuspidata.*
Russian-olive	*Elaeagnus angustifolia.*
Spiny aralia	*Acanthopanax divaricata.*
Do	*Acanthopanax henryi.*
Do	*Acanthopanax sessiliflorum.*
Colorado dogwood	*Cornus coloradensis.*
Red-osier dogwood	*Cornus stolonifera.*
Common persimmon	*Diospyros virginiana.*
Privet	*Ligustrum acuminatum.*
Do	*Ligustrum amurense.*
Do	*Ligustrum ciliatum.*
Do	*Ligustrum microcarpum.*
Do	*Ligustrum vulgare.*
Matrimony-vine	*Lycium chinense.*
Do	*Lycium rhombifolium.*
Arrowwood	*Viburnum acerifolium.*
American cranberry-bush	*Viburnum americanum.*
Withe-rod	*Viburnum cassinoides.*
Linden viburnum	*Viburnum dilatatum.*
Beech viburnum	*Viburnum erosum.*
Nannyberry	*Viburnum lentago.*
European cranberry-bush	*Viburnum opulus.*
Blackhaw	*Viburnum prunifolium.*
Southern blackhaw	*Viburnum rufidulum.*
Sargent's cranberry-bush	*Viburnum sargenti.*
Snowberry	*Symphoricarpos occidentalis.*
Do	*Symphoricarpos orbiculatus.*
Do	*Symphoricarpos racemosus.*
Do	*Symphoricarpos laevigata.*
Belle honeysuckle	*Lonicera bella.*
Sweetberry honeysuckle	*Lonicera caerulea.*
Limber honeysuckle	*Lonicera dioica.*
Amur honeysuckle	*Lonicera maackii.*
Grape honeysuckle	*Lonicera prolifera.*
Tartarian honeysuckle	*Lonicera tatarica.*

Table 2.—*Persistent fruits in the New York Botanical Garden, March 7, 1914*

Common name	Scientific name	Common name	Scientific name
Amur barberry	*Berberis amurense.*	Rose	*Rosa multiflora.*
Siebold's barberry	*Berberis sieboldii.*	Do.	*Rosa nitida.*
Japanese barberry	*Berberis thunbergi.*	Do.	*Rosa nutkana.*
European barberry	*Berberis vulgaris.*	Do.	*Rosa petersiana.*
Firethorn	*Cotoneaster rotundifolia.*	Do.	*Rosa rubiginosa.*
Do.	*Cotoneaster simonsi.*	Do.	*Rosa rugosa.*
Do.	*Cotoneaster vacillans.*	Do.	*Rosa solanderi.*
Hall crab apple	*Malus halliana.*	Do.	*Rosa spinosissima.*
Hawthorn	*Crataegus collina.*	Do.	*Rosa stylosa.*
Washington hawthorn	*Crataegus cordata.*	Do.	*Rosa villosa.*
Hawthorn	*Crataegus pentandra.*	Dwarf sumac	*Rhus copallina.*
Chinese hawthorn	*Crataegus pinnatifida.*	Staghorn sumac	*Rhus hirta.*
Hawthorn	*Crataegus rhombifolia.*	Finetooth holly	*Ilex serrata.*
Do.	*Crataegus scabrida.*	Common winterberry	*Ilex verticillata.*
Cockspur thorn	*Crataegus crusgalli.*	Privet	*Ligustrum ciliatum.*
Service berry	*Amelanchier asiatica.*	Ibota privet	*Ligustrum ibota.*
Red chokeberry	*Aronia arbutifolia.*	California privet	*Ligustrum ovalifolium.*
Purple chokeberry	*Aronia atropurpurea.*	European privet	*Ligustrum vulgare.*
Black chokeberry	*Aronia melanocarpa.*	Japanese beautyberry	*Callicarpa japonica.*
Beach plum	~~*Prunus maritima.*~~	C~~hinese beautyberry~~	*Callicarpa purpurea.*
Rose	*Rosa acicularis.*	Common matrimony-vine.	*Lycium halimifolium.*
Do.	*Rosa canina.*	Arrowwood	*Viburnum acerifolium.*
Do.	*Rosa copelandi.*	Viburnum	*Viburnum cotinifolium.*
Do.	*Rosa hispida.*	Linden viburnum	*Viburnum dilatatum.*
Do.	*Rosa humilis.*	Wayfaring-tree	*Viburnum lantana.*
Do.	*Rosa jundzillii.*	Smooth withe-rod	*Viburnum nudum.*
Do.	*Rosa lucida.*	European cranberrybush	*Viburnum opulus.*
Do.	*Rosa lyoni.*	Japanese honeysuckle	*Lonicera japonica.*
Do.	*Rosa micrantha.*		

Table 3 shows the relative popularity with birds of important genera of fleshy fruits.

TABLE 3.—*Fleshy fruits attractive to desirable birds*[1]

Common name	Scientific name	Number of species of birds known to eat the fruit[2]	Desirable kinds of birds most fond of the fruit[3]
Juniper; red cedar	Juniperus	39	Yellow-shafted flicker, evening grosbeak, pine grosbeak, purple finch, cedar waxwing, myrtle warbler, mocking bird, robin, eastern bluebird.
Greenbrier	Smilax	39	Cardinal, mocking bird, brown thrasher, catbird, hermit thrush, robin.
Bayberry	Myrica	73	Bobwhite, downy woodpecker, yellow-shafted flicker, eastern phoebe, meadow lark, chewink, tree swallow, white-eyed vireo, myrtle warbler, brown thrasher, catbird, Carolina wren, black-capped chickadee, hermit thrush, eastern bluebird.
Hackberry	Celtis	40	Yellow-bellied sapsucker, yellow-shafted flicker, cardinal, cedar waxwing, mocking bird, brown thrasher, robin, eastern bluebird.
Mulberry	Morus	52	Yellow-billed cuckoo, red-headed woodpecker, red-bellied woodpecker, downy woodpecker, kingbird, Baltimore oriole, orchard oriole, cardinal, purple finch, scarlet tanager, cedar waxwing, red-eyed vireo, yellow warbler, mocking bird, catbird, wood thrush, robin.
Pokeberry	Phytolacca	49	Mourning dove, yellow-shafted flicker, kingbird, cardinal, mocking bird, catbird, hermit thrush, gray-cheeked thrush, olive-backed thrush, robin, eastern bluebird.
Spicebush	Benzoin	17	Kingbird, red-eyed vireo, wood thrush, veery.
Sassafras	Sassafras	18	Bobwhite, kingbird, red-eyed vireo, catbird, veery, robin.
Strawberry	Fragaria	46	Chewink, catbird, brown thrasher, wood thrush, robin.
Raspberry; blackberry	Rubus	118	Ruffed grouse, bobwhite, red-headed woodpecker, yellow-shafted flicker, kingbird, Baltimore oriole, orchard oriole, pine grosbeak, song sparrow, fox sparrow, white-throated sparrow, chewink, California towhee, spurred towhee, cardinal, rose-breasted grosbeak, black-headed grosbeak, cedar waxwing, red-eyed vireo, mocking bird, catbird, brown thrasher, tufted titmouse, wren-tit, olive-backed thrush, wood thrush, robin, eastern bluebird.
Rose	Rosa	25	Ruffed grouse, sharp-tailed grouse, prairie chicken, bobwhite.
Mountain-ash	Sorbus	14	Red-headed woodpecker, Baltimore oriole, evening grosbeak, pine grosbeak, cedar waxwing, Bohemian waxwing, catbird, brown thrasher, robin.
Chokeberry	Aronia	13	Meadow lark, brown thrasher.
Red haw	Crataegus	33	Ruffed grouse, pine grosbeak, purple finch, robin.
Dwarf apples	Malus	(4)	Ruffed grouse, ringneck pheasant, red crossbill, pine grosbeak, purple finch, cedar waxwing, mocking bird, robin.
June berry	Amelanchier	40	Yellow-shafted flicker, Baltimore oriole, cedar waxwing, catbird, hermit thrush, veery, robin.
Wild cherry	Prunus	74	Ruffed grouse, bobwhite, mourning dove, red-headed woodpecker, yellow-shafted flicker, kingbird, Bullock's oriole, Baltimore oriole, orchard oriole, evening grosbeak, purple finch, rose-breasted grosbeak, black-headed grosbeak, Louisiana tanager, red-eyed vireo, cedar waxwing, mocking bird, catbird, brown thrasher, olive-backed thrush, wood thrush, robin, eastern bluebird.

[1] Barberries (Berberis), buckthorn (Rhamnus), and currants (Ribes) are omitted because they serve as alternate hosts of rusts attacking wheat, oats, and white pine, respectively.
[2] When 10 or more.
[3] Included on the basis of field observation or because fruit was found in 10 or more stomachs.
[4] Thirty-eight kinds of birds are known to feed on apples of various sorts, but it is not known just how many seek the small-fruited ornamental flowering apples, which are the best to plant for birds.

TABLE 3.—*Fleshy fruits attractive to desirable birds*—Continued

Common name	Scientific name	Number of species of birds known to eat the fruit	Desirable kinds of birds most fond of the fruit
Sumac [5]	Rhus	93	Ruffed grouse, bobwhite, valley quail, downy woodpecker, red-bellied woodpecker, red-shafted flicker, yellow-shafted flicker, phoebe, goldfinch, golden-crowned sparrow, chewink, white-eyed vireo, Audubon warbler, mocking bird, catbird, California thrasher, brown thrasher, Carolina wren, black-capped chickadee, Carolina chickadee, wren-tit, hermit thrush, robin, eastern bluebird.
Pepper berry	Schinus	11	Cedar waxwing, phainopepla, hermit thrush, varied thrush, robin.
Holly	Ilex	45	Ruffed grouse, bobwhite, valley quail, yellow-bellied sapsucker, yellow-shafted flicker, cedar waxwing, mocking bird, catbird, brown thrasher, hermit thrush, robin, eastern bluebird.
Supple-jack	Berchemia	13	Mocking bird, robin.
Buckthorn	Rhamnus	16	Mocking bird, catbird, brown thrasher, robin.
Wild grape	Vitis	77	Ruffed grouse, bobwhite, pileated woodpecker, red-bellied woodpecker, red-shafted flicker, yellow-shafted flicker, kingbird, cardinal, cedar waxwing, mocking bird, catbird, brown thrasher, wood thrush, veery, robin, western bluebird, eastern bluebird.
Virginia creeper	Parthenocissus	39	Red-headed woodpecker, red-bellied woodpecker, yellow-bellied sapsucker, yellow-shafted flicker, evening grosbeak, purple finch, scarlet tanager, red-eyed vireo, mocking bird, brown thrasher, tufted titmouse, hermit thrush, olive-backed thrush, gray-cheeked thrush, robin, eastern bluebird.
Buffalo berry	Shepherdia	16	Sharp-tailed grouse, pine grosbeak.
Silverberry, Russian olive, etc.	Elaeagnus	([6])	Sharp-tailed grouse, prairie chicken, cedar waxwing, catbird, robin.
Wild sarsaparilla	Aralia	14	Bobwhite, robin.
Dogwood	Cornus	86	Ruffed grouse, bobwhite, downy woodpecker, yellow-shafted flicker, red-shafted flicker, kingbird, evening grosbeak, pine grosbeak, purple finch, white-throated sparrow, song sparrow, cardinal, cedar waxwing, warbling vireo, red-eyed vireo, catbird, brown thrasher, hermit thrush, olive-backed thrush, gray-cheeked thrush, wood thrush, robin, eastern bluebird.
Sour gum	Nyssa	36	Yellow-shafted flicker, purple finch, cedar waxwing, gray-cheeked thrush, olive-backed thrush, robin.
Crowberry	Empetrum	16	Pine grosbeak, snowflake.
Bearberry	Arctostaphylos	16	Ruffed grouse, dusky grouse, valley quail, mountain quail, fox sparrow, wren tit.
Huckleberry	Gaylussacia	35	Pine grosbeak, chewink, robin.
Blueberry	Vaccinium	67	Ruffed grouse, valley quail, kingbird, orchard oriole, pine grosbeak, chewink, cedar waxwing, catbird, brown thrasher, black-capped chickadee, tufted titmouse, hermit thrush, robin, eastern bluebird.
Beautyberry	Callicarpa	10	Mocking bird, brown thrasher.
Partridge berry	Mitchella	10	Ruffed grouse.
Elderberry	Sambucus	106	Valley quail, red-headed woodpecker, yellow-shafted flicker, eastern kingbird, Arkansas kingbird, black phoebe, California towhee, white-crowned sparrow, rose-breasted grosbeak, black-headed gros beak, phainopepla, red-eyed vireo, mocking bird, catbird, brown thrasher, California thrasher, wren-tit, olive-backed thrush, robin, western bluebird, eastern bluebird.
Snowberry	Symphoricarpos	25	Sharp-tailed grouse, evening grosbeak, pine grosbeak, varied thrush.
Black haw	Viburnum	28	Ruffed grouse, yellow-billed cuckoo, yellow-shafted flicker, purple finch, rose-breasted grosbeak, cedar waxwing, catbird, brown thrasher, robin, eastern bluebird.
Honeysuckle	Lonicera	15	Bobwhite, pine grosbeak, white-throated sparrow, catbird, mocking bird, brown thrasher, hermit thrush, robin.

[5] Only nonpoisonous species of sumac are considered.

[6] Data given are based entirely on field observations; total number of birds eating the various species of Elaeagnus unknown.

The species listed in Table 4 are selected from a much larger number which are known to be favorites with fruit-eating birds. Various considerations have influenced choice, as ornamental value, earliness,

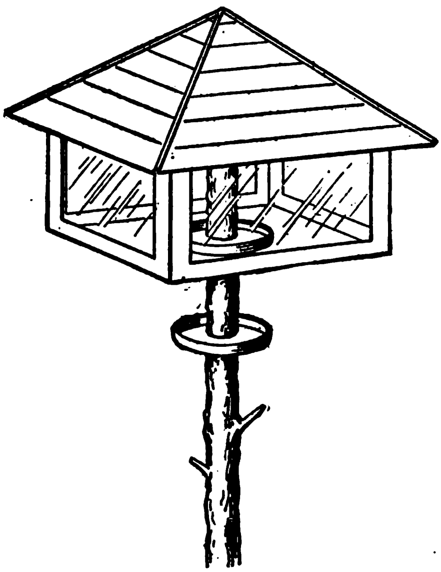


FIGURE 10.—Food house

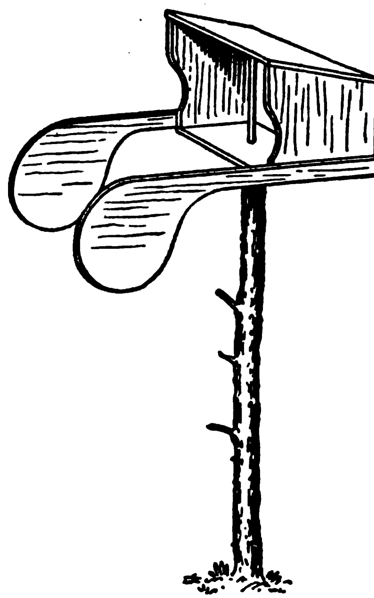
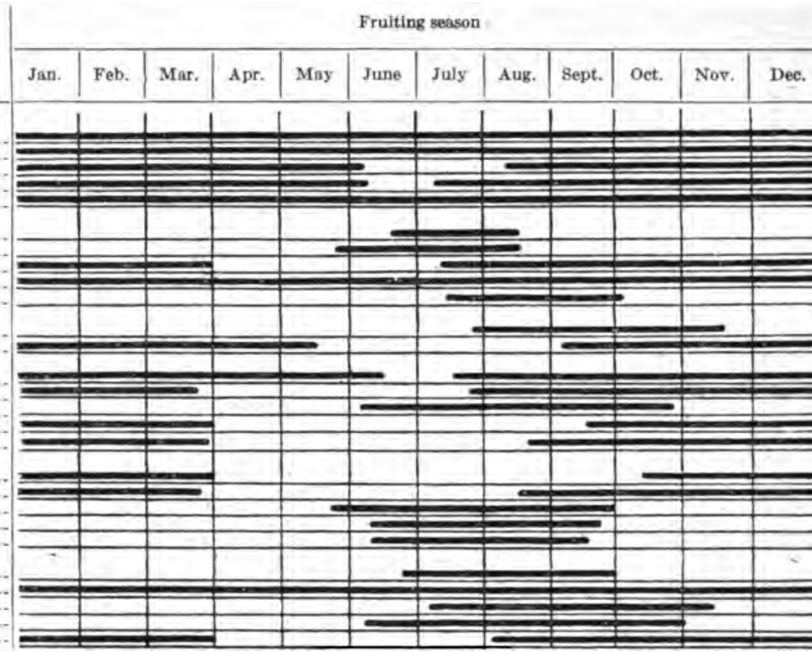


FIGURE 11.—Food house on pivot

lateness, or length of fruiting season, and especially availability of the plants through ordinary channels of trade. The data on fruiting seasons have been compiled from the principal herbaria of the Northeastern States, with a few additions from other sources.

Table 4.—*Seasons of fruits attractive to birds*

Common name	Scientific name	Native or introduced
Juniper	*Juniperus communis*	Native
Red cedar	*Juniperus virginiana*	do
Greenbrier	*Smilax rotundifolia*	do
Bayberry	*Myrica carolinensis*	do
Hackberry	*Celtis occidentalis*	do
Red mulberry	*Morus rubra*	do
White mulberry	*Morus alba*	Introduced
Pokeweed	*Phytolacca decandra*	Native
Japanese barberry	*Berberis thunbergi*	Introduced
Sassafras	*Sassafras variifolium*	Native
Spicebush	*Benzoin aestivale*	do
Flowering crab apple	*Malus floribunda*	Introduced
Chokeberry	*Pyrus melanocarpa*	Native
Mountain-ash	*Pyrus americana*	do
June berry	*Amelanchier canadensis*	do
Asiatic service-tree [1]	*Amelanchier asiatica*	Introduced
Cockspur thorn	*Crataegus crus-galli*	Native
Washington hawthorn	*Crataegus phaenopyrum*	Introduced
English hawthorn	*Crataegus oxyacantha*	do
Wild strawberry	*Fragaria americana*	Native
Wild blackberry	*Rubus allegheniensis*	do
Wild blackberry	*Rubus triflorus*	do
Wild blackberry	*Rubus canadensis*	do
Pasture rose [2]	*Rosa humilis*	do
Wild black cherry	*Prunus serotina*	do
Wild red cherry	*Prunus pennsylvanica*	do
Beach plum [2]	*Prunus maritima*	do



[1] Apparently procurable only from foreign dealers.

[2] Fruit becoming dry at end of season.

TABLE 4.—*Seasons of fruits attractive to birds*—Continued

Common name	Scientific name	Native or introduced	Fruiting season: Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct	Nov.	Dec.
Sand cherry	*Prunus pumila*	Native												
Crowberry	*Empetrum nigrum*	do												
Smooth sumac	*Rhus glabra*	do												
Fragrant sumac	*Rhus aromatica*	do												
Holly [1]	*Ilex opaca*	do												
Inkberry [1]	*Ilex glabra*	do												
Black alder [1]	*Ilex verticillata*	do												
Mountain-holly [1]	*Nemopanthus mucronata*	do												
Bittersweet	*Celastrus scandens*	do												
Buckthorn	*Rhamnus cathartica*	Introduced												
Virginia creeper	*Psedera quinquefolia*	Native												
Japanese creeper [2]	*Ampelopsis tricuspidata*	Introduced												
Summer grape [2]	*Vitis aestivalis*	Native												
Frost grape	*Vitis vulpina*	do												
Leatherwood	*Dirca palustris*	do												
Wild pepper	*Daphne mezereum*	Introduced												
Oleaster [2]	*Elaeagnus angustifolia*	do												
Buffalo berry	*Shepherdia canadensis*	Native												
Wild sarsaparilla	*Aralia nudicaulis*	do												
Spiny aralia [2]	*Acanthopanax sessiliflorum*	Introduced												
Bunchberry	*Cornus canadensis*	Native												
Flowering dogwood	*Cornus florida*	do												
Red osier [2]	*Cornus stolonifera*	do												
Alternate-leaved dogwood	*Cornus alternifolia*	do												
Sour gum	*Nyssa sylvatica*	do												
Wintergreen	*Gaultheria procumbens*	do												
Bearberry	*Arctosaphylos uva-ursi*	do												
Creeping snowberry	*Chiogenes hispidulus*	do												
Black huckleberry	*Gaylussacia baccata*	do												
Early sweet blueberry	*Vaccinium pennsylvanicum*	do												
Swamp blueberry	*Vaccinium corymbosum*	do												
Cranberry	*Vaccinium macrocarpon*	do												
Persimmon [3]	*Diospyros virginiana*	do												
Privet	*Ligustrum vulgare*	Introduced												
Beautyberry	*Callicarpa purpurea*	do												

Partridge berry	*Mitchella repens*	Native
Sweetberry honeysuckle [1]	*Lonicera caerulea*	do
Tartarian honeysuckle [2]	*Lonicera tatarica*	Introduced
Snowberry	*Symphoricarpos racemosus*	Native
Coralberry	*Symphoricarpos vulgaris*	do
High-bush cranberry	*Viburnum opulus*	do
Arrowwood	*Viburnum acerifolium*	do
Sheepberry	*Viburnum lentago*	do
Common elder	*Sambucus canadensis*	do
Red-berried elder	*Sambucus racemosa*	do

[1] Fruit becoming dry at end of season.

[2] Sexes tending to be on separate plants; both required.

Notes on the List in Table 4

Bayberry. Usual trade name is *Myrica cerifera*.
Hackberry. Fruit scarce in late May and June. *Celtis serrata*, *C. bungeana*, or *C. mississippiensis* may be substituted.
Mulberry. *Morus tatarica* may be used.
Pokeweed. Let it grow through shrubs or a trellis which will support it in winter.
Sassafras. Appears in most catalogs as *S. officinale* or *S. sassafras*.
Flowering apple. The following may be substituted: *Malus baccata*, *M. halliana*, *M. parkmanni*, *M. sargenti*, and *M. toringo*.
Chokeberry. Often called *Pyrus* or *Aronia nigra*. *P. arbutifolia*, another native species, retains its fruit just as long, but the fruit becomes very dry toward the end of the season.
Cherry. *Prunus cerasifera*, *P. fruticosus*, *P. japonica pendula*, *P. sargenti*, and *P. tomentosa*, all introduced, are worth adding.
Sumac. *Rhus copallina* or *R. hirta* (*typhina*) may be substituted for *R. glabra*.
June berry. *Amelanchier canadensis*, sold by nurserymen, is a composite species. Several species are now recognized, among which *A. laevis* is a notably early fruiter and *A. sanguinea* a late one. Some fruit of June berries occasionally hangs much later than the season indicated, but is in very dry condition.
Hawthorns. The species recommended are those usual in the trade. So far as desirability is concerned many native species could be substituted. Cotoneasters, such as *Crataegus coccinea*. *C. horizontalis*, *C. microphylla*, *C. rotundifolia*, and *C. tomentosa*, also may be used.
Strawberry. Often called *Fragaria vesca americana*. *F. virginiana* is a fair substitute. Little dealt in; must usually be transplanted from woods and fields.
Blackberry. *Rubus triflorus* is frequently called *R. americanus*.
Rose. All native species have persistent fruit. The small-fruited ones are best for birds. *Rosa carolina* and *R. nitida* are suitable for low grounds; and *R. humilis* (sometimes called *virginiana*) and *R. setigera* may be planted in drier places. *R. micrantha* and *R. multiflora* are among the best introduced roses.
Black alder. *Ilex laevigata* may be used instead of *I. verticillata*. *I. serrata* is a good introduced species.
Mountain-holly. Drops most of its berries in the fall; only a few persist throughout the season indicated.
Bittersweet. *Celastrus orbiculatus*, introduced, may be used.
Virginia creeper. Often sold under the names *Ampelopsis* and *Parthenocissus*. *A. heterophylla* and *P. vitacea* may be substituted.
Wild pepper. *Hippophaë rhamnoides* may replace it, especially along coast.
Oleaster. *Elaeagnus longipes*, *E. multiflora*, *E. parviflora*, and *E. umbellata* also are good.
Buffalo berry. *Shepherdia* (*Lepargyrea*) *argentea*, the true buffalo berry, furnishes good bird food.
Dogwood. *Cornus paniculata* (*candidissima*), native, and *C. alba* and *C. sanguinea* introduced, are worthy substitutes.
Huckleberry. *Gaylussacia baccata* is often sold as *G. resinosa*.
Blueberry. Any species may be substituted.
Cranberry. Generic name often given as Oxycoccus.
Privet. *Ligustrum acuminatum*, *L. amurense*, *L. ciliatum*, *L. ibota*, and *L. microcarpum*, all introduced, are equally good. Must not be clipped; berries borne on outer twigs.
Beautyberry. Variety *japonica* is the hardy form.
Honeysuckle. *Lonicera glauca*, *L. canadensis*, *L. oblongifolia*, and *L. sempervirens*, native, and *L. maackii*, introduced, may be substituted.
Snowberry. *Symphoricarpus occidentalis* is just as good.
Viburnum. *V. dentatum*, native, and *V. sieboldii*, introduced, are worth adding.
Elder. *Sambucus nigra*, introduced, also is valuable.

The fruiting seasons indicated include the earliest and latest dates recorded for the Northeastern States. Hence it can not be expected that fruit will be available in any one locality throughout the entire bearing season of a plant unless a large number of plants are set out and in a variety of situations. Purchasers may obtain information from nurseries as to where, when, and how to plant.[5] Notes on species which may be substituted for some of those in the main list, and other comments, follow the table.

PROTECTING CULTIVATED FRUITS

Birds devour cultivated fruit principally because the processes of cultivation diminish the wild supply. The presence of wild fruit in a locality always serves to protect domestic varieties, especially when the wild trees or shrubs are of the same kind as the cultivated ones and ripen earlier.

Table 5 (p. 17) shows in a graphic way the species which may be used to protect the principal classes of cultivated fruits.

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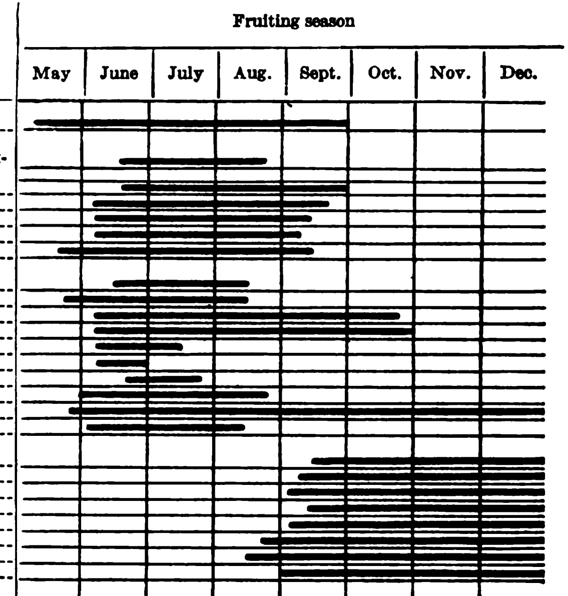
[5] They may consult to advantage also Farmers' Bulletin 1567, Propagation of Trees and Shrubs.

TABLE 5.—*Seasons of fruits useful to protect cultivated varieties*

Common name	Scientific name	Native or introduced	To protect—
Wild strawberry	*Fragaria americana*	Native	Strawberries
Baked-apple berry	*Rubus chamaemorus*	do	Raspberries and blackberries.
Wild blackberry	*Rubus canadensis*	do	do
Wild blackberry	*Rubus allegheniensis*	do	do
Wild blackberry	*Rubus triflorus*	do	do
Wild blackberry	*Rubus frondosus*	do	do
Wild pepper	*Daphne mezereum*	Introduced	do
Red mulberry	*Morus rubra*	Native	Cherries
White mulberry	*Morus alba*	Introduced	do
June berry	*Amelanchier canadensis*	Native	do
Wild red cherry	*Prunus pennsylvanica*	do	do
Japanese cherry	*Prunus japonica pendula*	Introduced	do
Sargent cherry[1]	*Prunus sargenti*	do	do
Mahaleb cherry	*Prunus mahaleb*	do	do
Fly honeysuckle	*Lonicera canadensis*	Native	do
Sweetberry honeysuckle	*Lonicera caerulea*	do	do
Red berried elder	*Sambucus racemosa*	do	do
Asiatic servicetree[1]	*Amelanchier asiatica*	Introduced	Apples and pears
Silky-leaved pear[1]	*Pyrus elaeagnifolium*	do	do
Flowering crab apple	*Malus floribunda*	do	do
Dwarf crab apple	*Malus toringo*	do	do
Hybrid crab apple[1]	*Malus prunifolia*	do	do
Cockspur thorn	*Crataegus crus-galli*	Native	do
English hawthorn	*Crataegus oxyacantha*	Introduced	do
One-seeded hawthorn	*Crataegus monogyna*	do	do



[1] Apparently procurable only from foreign dealers.

PLANTS FOR THE SHORE

Where the coast is rocky and the soil of ordinary character, conditions are little different from those inland, and except in relation to exposure there need be no especial preference given in the choice of plants. It is worth mentioning, however, that several trees and shrubs are better adapted to withstand the winds so prevalent on the coast. These include three species of juniper (*Juniperus communis*, *J. horizontalis*, and *J. virginiana*), common barberry, English hawthorn, hybrid crab apple, European and American mountain-ashes, smooth and staghorn sumacs, privet, and red-berried elder. Where the soil is chiefly sand, and that often shifting, conditions are not suited to many plants. Selection may be made, however, from the following, all of which are known to thrive in such surroundings.

For seed eaters.—Beach grass (*Ammophila arenaria* and *Calamovilfa longifolia*), *Polygonum sachalinense*, and sunflower.

For fruit eaters.—Bayberry (*Myrica cerifera*), sea buckthorn (*Hippophaë rhamnoides*), sand cherry (*Prunus pumila* or *P. cuneata*), beach plum (*Prunus maritima*), cranberries, and bearberry (*Arctostaphylos uva-ursi*).

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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

622

Contribution from the Forest Service, Henry S. Graves, Forester, December 10, 1914.

BASKET WILLOW CULTURE.

By GEORGE N. LAMB, *Scientific Assistant, Forest Service.*

This bulletin discusses the different varieties of basket willows and methods of willow growing which have been found most satisfactory as a result of experiments conducted at the Forest Service willow farm at Arlington, Va., and a study of willow holts established throughout the country. The opportunities for marketing the products of the holt, and the cost of establishment and maintenance, are also discussed.

RANGE OF WILLOW GROWING.

There are nearly 200 species of willows. A basket willow is any one of these that produces long, straight rods suitable for weaving baskets. A number of species have been used for this purpose, and in Europe, where willows have been cultivated for many years, some have shown a decided superiority over the others. Several of these cultivated European varieties have been introduced into the United States and are now widely distributed. As shown in figure 1, however, basket willows are not at present grown commercially over nearly so great a range as they might be. The Forest Service has distributed thousands of cuttings in the last few years, and though many trials have been failures, largely on account of unfamiliarity with the willows' requirements, there have been enough successful plantings to indicate that willows can be grown in all parts of the country, except in the arid and semiarid regions, at high altitudes, and in portions of the South. Along the Mississippi, however, they have grown well almost to the Gulf.

SELECTION OF A SITE.

Special care should be used in selecting a site for a willow holt, since success very largely depends upon the proper situation. The points to be taken into account are discussed in the following paragraphs.

NOTE.—This bulletin is of interest to those engaged in or contemplating basket-willow culture, and is applicable to all portions of the country where willows are grown.

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The first consideration is moisture. The ideal site is one where the water table is within from 2 to 6 feet of the surface, insuring a constant and sufficient water supply, while the surface remains dry enough to permit thorough cultivation. If a choice must be made

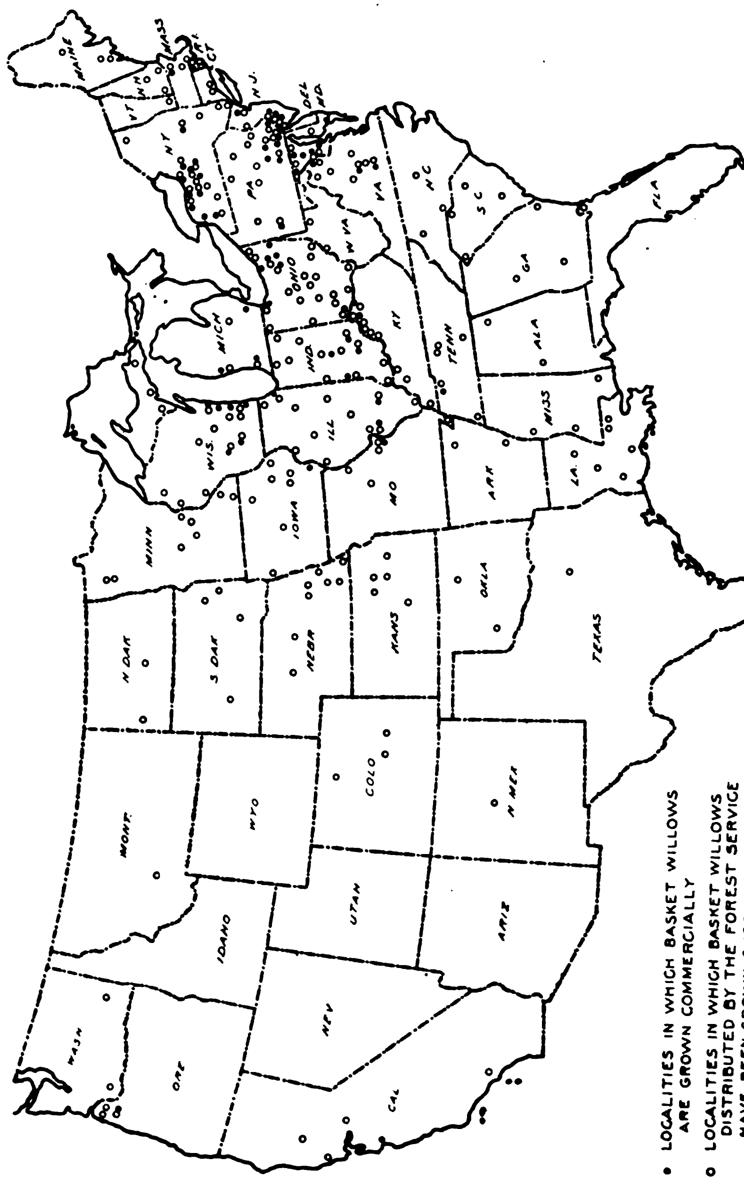


FIG. 1.—Range of basket-willow growing in the United States.

between a situation which is too wet and one which may be too dry at certain seasons, it is better to take the drier situation, unless it is actually subject to severe drought. The more uniform the supply of moisture the better the growth.

With favorable moisture conditions, basket willows will grow on a wide range of soils, though the ideal soil is a loose, sandy loam. They will not produce well on soils that are excessively acid or excessively alkaline. If the soil is either sour or alkaline, a sample should be sent to the State experiment station for analysis to determine the proper means of neutralizing it. Physical condition is usually much more important than fertility, since most soils contain the necessary food materials to supply the requirements of willows.

A holt situated in a stream bottom, partly or wholly surrounded by trees which check the winds and keep the dew on the willows until late in the day, presents almost perfect conditions for the attacks of insects and development of fungous diseases. The most successful holts in this country are placed so that they receive the full sweep of the wind. Fungi and insects are much less common and much less destructive in holts in which a free circulation of air is maintained. Proper circulation is difficult to obtain in close-spaced holts, especially where large-leaf varieties are used.

The likelihood of weeds springing up is another thing to consider in selecting a site for a holt. Situations near areas of waste lands in weeds should be avoided. The expense of keeping the holt clean will be much greater if there is a crop of uncut weeds in the vicinity to furnish a plentiful supply of seeds to restock the ground as fast as it is cultivated. It is very difficult to keep a holt free from dodder if it grows abundantly on near-by weeds, especially if the willows are dense and the situation moist.

The final thing to consider in connection with the site for a holt is convenience. A holt can be more economically worked when near at hand, but the most important reason for having it accessible is that it may be constantly under the eye of the grower. When seen in time, many insects, fungi, and weeds can be eradicated by a few minutes' work. If let alone for a week or two, however, serious damage is likely to be done, and measures of suppression will require considerable labor.

PREPARATION OF SOIL.

The majority of willow holts in this country are established on land which has not previously been cultivated. Willows planted in poorly cultivated soil are from the very start forced to contend with an abundant crop of strong-growing weeds, many of which come up from well-established roots. The soil, moreover, is usually root bound and in poor condition either for the growth of the plants or for cultivation. Many failures to establish holts are due to lack of proper preparation of the ground.

If new land is to be used for a willow holt, it should be broken the year before the willows are to be planted. Such work should be done in the spring, and, if possible, the land planted to corn or potatoes or some other annual crop that requires clean cultivation. Potatoes are best, since they tend to thoroughly loosen the soil. If not sowed to a crop, the land should at least lie fallow and be free from weeds. Late in the fall it should be plowed, manured if necessary, and left to weather during the winter. The following spring it should again

FIG. 2.—*Salix amygdalina* (American green willow).

FIG. 3.—*Salix amygdalina* (Silver skin).

be plowed, disked, and harrowed, care being taken not to leave any depressions in which water might stand later. Where there is a likelihood of excessive rain during the early spring, and the soil is heavy, the land should be made ready for planting in the fall. This would apply particularly to low areas subject to spring flooding, which would delay planting for a month or more. Early planting is of the utmost importance, and any delay would mean a handicap not easy to overcome.

WHAT TO PLANT.

The farmer who contemplates planting willows should confine himself, as a rule, to the American green and to the patent Lemley or Lemley. These require much less cultivation than the purple willow, are easily peeled, and bring good prices. Perhaps after both have been grown for a few years one or the other may prove more desirable, and in that event the inferior variety may be gradually

FIG. 4.—*Salix amygdalina* (Küstermann willow).

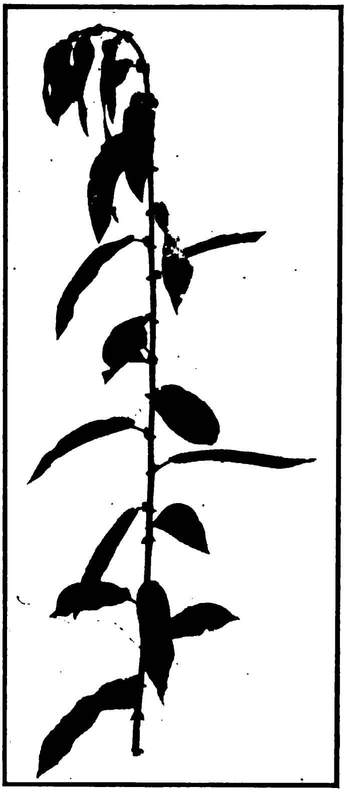


FIG. 5.—*Salix amygdalina americana* (American willow).

removed. In small holts, where insects and fungous pests can be controlled, American green is recommended. In large holts, however, it would be safer to plant the Lemleys, since there would be much less likelihood of loss by epidemic. In places where the cost of peeling would not be great the purple willow, which produces very high-class material, might be profitable.

THE AMERICAN GREEN WILLOWS.

The American green willows (*Salix amygdalina* L.) (figs. 2 to 5) have gained in popularity both in Europe and America in recent years. As a whole, the group is much sturdier than the purple willows and will produce a paying crop under much more adverse conditions. They will also stand heavier soils and more moisture. They have grown well not only in the North, but also along the Mississippi as far south as lower Louisiana. In all parts of the South they have succeeded better than any other species.

FIG. 6.—Patent Lemley variety (*Salix pentandra* L.), taken in June.

American green willows are easy to peel, and on account of their large size the peeling can be done at a lower cost per pound. Under the most favorable conditions yields as high as 12 and 15 tons per acre have been obtained, though the average is from 6 to 9 tons. When open grown these willows have a tendency to branch. Close spacing is best in every case, since it lessens the need for cultivation and gives more and better rods. There is little danger of the plants becoming stunted through crowding.

American green is much in demand by makers of furniture and of the heavier and better grades of basket ware. It is by far the best basket willow grown in America, but unfortunately is subject to insect attacks and disease. The willow-shoot sawfly, the stool borer, and the leaf rust often invade a holt and do a great deal of damage. These pests can be controlled, though this often entails considerable expense. Even with this drawback, however, American green has been planted in a large proportion of recently established holts.

The American willow (*Salix amygdalina americana*) can generally be planted in any place where the American green will grow, and is especially desirable when small rods are required. Except in such a case it is not advisable to plant this variety on very poor soils. The rods are not as uniform, nor is the yield as high as in the case of American green.

LEMLEY AND PATENT LEMLEY WILLOWS.

The Lemley (*Salix pentandra minor*) and patent Lemley (*Salix pentandra major*) varieties (figs. 6 and 7) are very similar in general requirements. Both grow best on a loose, sandy loam, with an abundant supply of moisture. Heavy clays should be avoided. If such soil is utilized, however, it should be deeply plowed, and should receive an application of lime if acid. These willows are strongly recommended on account of their comparative freedom from disease and insects. Though smaller than the American green, they are large enough for sap peeling.

Both Lemleys have a decided tendency to branch at the base, especially when open spaced. Some growers send children through a holt to pick off these lateral branches. The rods, especially of the Lemley, are inclined to curve at the base. This makes it necessary to prepare such rods for the market with particular care, but properly bundled they are well liked by manufacturers. Under favorable conditions the species should yield as high as 10 tons per acre, but the average is from 5 to 8 tons.

FIG. 7.—Lemley variety (*Salix pentandra* L.), taken in June.

PURPLE WILLOWS.

Of the several varieties of purple willows (figs. 8 to 11) grown in this country, the common variety (*Salix purpurea* L.) planted in western New York is perhaps the most satisfactory. While not recommended generally except for steam peeling, every willow grower should have a few plants in his holt, increasing the proportion as he is able to use the material. All the purple willows, especially the narrow-leaf variety, are very useful as cordage in tree nurseries and even in the willow holt itself.

These willows thrive best on moist, well-drained, sandy loams, but can be grown in a variety of soils. The rods are naturally tough and hard, and, unlike the American green, will grow on very fertile soil

FIG. 8.—*Salix purpurea latifolia* (Wide-leaf purple willow).

FIG. 9.—*Salix purpurea rubra* (Red purple willow).

without becoming soft and brittle. On poor soils the purple willow shows a decided tendency to become stunted, especially when close spaced, unless the ground is properly fertilized. Under favorable conditions, purple willow yields as high as 8 tons to the acre, but when open spaced and poorly cultivated, the yield may fall to from 2 to 3 tons. Five tons is an average yield. The small size of these willows makes the per pound cost of peeling higher than for the American green or the Lemleys. Sap-peeled rods, well sorted and bundled, however, bring from 6 to 9 cents a pound.

FIG. 10.—*Salix purpurea* (Common purple willow).

OTHER VARIETIES.

Of the other varieties occasionally grown or advertised in this country, few give any promise of success. The Caspian willows (*Salix daphnoides* Vill.) (fig. 12) produce a very fine rod, tall, straight, and cylindrical, which is soft, and splits readily. Unfortunately, they do not yield well, and should not be planted except in a small way for experimental purposes. Both the white and black osier (*Salix viminalis* and *S. dasyclades* L.) are worthless in the Eastern, Central, and Southern United States, though both may do well in the Northwest. Küstermann willow (fig. 4), known to the trade in Europe as *S. fragilis triandra*, has been grown successfully in Wisconsin and Virginia. It does not produce as good rods as the American green, but is freer from branches and disease.

WILLOW CUTTINGS.

All basket-willow holts are started from cuttings from shoots or branches. Too much care can not be taken in securing the best stock available for this purpose, since the plants should last for from 12 to 15 years, or longer. It is often a good plan to visit one or more near-by holts during the summer preceding the time of planting, in order to study the methods used and also to gather an idea of the kind of material produced. If it appears to be vigorous and thrifty, with no signs of insects or fungi, that particular holt will be a safe place from which to secure planting stock. In case the nearest willow holts are too far away to permit of inspection, it is a good plan to send for samples of the average rods of the varieties wished. August is the best time for this. Much confusion exists in regard to the trade names of willows, and if there is any doubt as to the identity of those received, specimens should be sent to the nearest State experiment station or to the Department of Agriculture for identification. If cuttings are purchased, very definite specifications should be made as to the length, age, and average weight per thousand cuttings. The prices range from $1 per thousand of 10-inch cuttings of the purple willows, made with a saw, and the number estimated by measuring, to $5 per thousand for 2-year-old 14-inch cuttings. Good 1-year-old cuttings of purple willow should bring a profit when sold at from $1.25 to $1.50 per thousand. One-year-old cuttings of Lemley or patent Lemley return a fair profit if sold at from $1.50 to $2 a thousand. These prices are usually quoted for quantities of a thousand cuttings or over, but for less than this number prices are often double these figures. Many persons have begun the cultivation of willows with a few hundred cuttings, and then gradually enlarged their holts as their supply of willows and knowledge of willow growing increased.

FIG. 11.—*Salix purpurea gracilis* (Slender purple willow).

WHEN TO MAKE CUTTINGS.

The proper time to prepare cuttings will depend upon the region, and whether planting is to be done in the fall or in the spring. If in the fall, the cuttings can be made about 2 weeks after the last leaves have fallen from the shoots, or, better still, after several heavy frosts have ripened the wood. The usual time to plant, however, is in the spring, and in this case cuttings can be made at any time from early winter until growth starts. Cuttings made six weeks or more before planting time are better, as a rule, than those made later, since in the former case there is time for them to callous over at each end. Callous cuttings start growth much more quickly than freshly made ones. Cuttings made after growth has begun in the spring grow poorly, and many of them fail to survive the first year. Except under the most favorable conditions weak plants will not produce merchantable rods.

SELECTION OF MATERIAL.

Any defect or injury in the shoot which is planted may later develop into a serious trouble. If the injury is merely mechanical, and consists only of a spot from which the bark has been removed, the wound may heal over with the vigorous growth of the new plant. There is always the danger, however, that it may not heal over, and so provide a point of entrance for some organism of decay. Shoots which have any diseased parts should be discarded or the diseased portions removed. The base of a willow rod often shows a discolored center, which indicates the presence of a rot which has entered the rod from a diseased stool. Cuttings from such material will start as well as any others, but the disease remains and gradually spreads until the productivity of the stool is destroyed. Selected cuttings—that is, those from tall, dominant shoots—give the best results, and any extra expense involved is more than made up in the larger yields for the first two years and in the relatively fewer fail places in the holt. Experiments made at Arlington with selected and unselected cuttings of American green, Lemley, and patent Lemley willows showed the plants from selected cuttings to be better in almost every way than those from the unselected ones. The only experience which contradicts these observations was that obtained from planting a few tip and butt cuttings of a strain of American green very late in May after growth had begun. In this case the tip cuttings made a better growth, due to the fact that at that time of the year the base of the shoot contained much less food material than the tips.

FIG. 12.—*Salix daphnoides* (Caspian willow).

SIZE AND AGE OF CUTTINGS.

For planting on a good, well-drained, sandy loam that has been under cultivation and carefully prepared, cuttings of 1-year-old shoots, from 10 to 12 inches long, give good results. For planting on poorly prepared ground, where weeds or other plants are already established, or where the soil is in poor physical condition, better results can be obtained with cuttings from 2-year-old shoots, from 12 to 18 inches long. Under any conditions 2-year-old planting stock makes a thriftier growth at first than cuttings from 1-year-old shoots, though this difference is not great on favorable sites, and disappears entirely after the second year.

NUMBER OF CUTTINGS OBTAINED FROM DIFFERENT WILLOWS.

The number of cuttings which can be secured from a given weight of willows varies with the species and, to some extent, with the crops of different years. Shoots produced in a favorable season are often 20 per cent larger than those of a season with an early drought. American green cuttings invariably weigh more than other kinds, although patent Lemley sometimes weighs almost as much. Purple willow cuttings are generally the lightest. Table 1 shows for different varieties of willows the average number of 1-foot cuttings which can be made from 50 pounds of rods. To secure the data given in the table only first-class material was used, all small and injured shoots, as well as the tips of the rods, being discarded.

TABLE 1.—*Average number of 1-foot cuttings made from 50 pounds of rods.*

Variety.	Weight of rods.	Number of cuttings made from 50 pounds of rods.	Weight of these cuttings.	Weight of cuttings per 1,000.	Amount of waste.	Per cent of waste.
	Pounds.		*Pounds.*	*Pounds.*	*Pounds.*	
Purple willow	50	3,000	33.25	11.08	16.75	33.5
Lemley willow	50	2,450	42.5	17.7	7.5	15.0
American willow	50	2,225	38.5	17.3	11.5	23.0
Patent Lemley	50	2,125	39.4	18.5	10.7	21.75
American green	50	1,525	44.3	29.6	5.7	11.25

Table 2 shows the number of 1-foot cuttings which it is possible to make from 50 pounds of material, discarding nothing but crooked or split butts and short tips. The figures given were obtained in 1911, a normal season for basket willows.

TABLE 2.—*Number of 1-foot cuttings possible from 50 pounds of rods.*

Variety.	Weight of rods.	Weight of discarded portions of shoots.			Weight of cuttings made from 50 pounds.	Number of cuttings made from 50 pounds.	Weight of 1 000 cuttings.
		Tips.	Butts.	Total.			
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*		*Pounds.*
Purple willow	50	4.5	3.0	7.5	42.5	4,500	9.2
American willow	50	6.5	4.5	11.0	39.2	4,000	10.0
Lemley	50	10.0	4.0	14.0	36.0	3,000	12.0
American green	50	3.25	3.25	6.5	43.5	1,289	35.0

Table 3 shows the relative number of first, second, and third class 1-foot cuttings obtained from 50 pounds of American green rods, the per cent each class formed of the total number, and the per cent of the weight of each class of the total weight.

TABLE 3.—*Relative number of first, second, and third class 1-foot cuttings obtained from 50 pounds of rods.*

	Number of cuttings made from 50 pounds of rods.	Weight of these cuttings.	Weight per 1,000 cuttings.	Per cent of total weight.	Per cent of total number.
		Pounds.	*Pounds.*		
Class I	243	16.0	67.8	32.0	18.9
Class II	772	23.0	29.3	46.0	59.8
Class III	274	4.0	14.6	8.0	21.3
Total	1,289	[1] 43.0	[2] 33.0	100.0	100.0

[1] Seven pounds of the 50 pounds of rods were waste. [2] Average weight per thousand.

Table 4 shows the relative weights of 3-foot cuttings from different species of willow. Except in the case of American green, the waste entailed in making 3-foot cuttings is always greater than that from making 1-foot cuttings.

TABLE 4.—*Weight of 1,000 3-foot cuttings.*

Species.	Weight of 1,000 cuttings.	Species.	Weight of 1,000 cuttings.
	Pounds.		*Pounds.*
American green (butts)	74	Patent Lemley	65.5
American green (tops)	56	Purple No. 2	59.5
American green (mixed)	64	American	63.5
Purple [1]	36.5	Lemley	53.0

[1] Rods rather short. In a normal season they would weigh about 40 pounds per thousand.

HOW TO MAKE CUTTINGS.

Where only a few cuttings are to be made an ordinary knife will do the work satisfactorily. For making a few thousand, pruners, a corn knife, or a hatchet can be used. Using the ordinary type of large orchard pruners, two men can easily cut, count, and tie in bundles 5,000 American green or 7,000 purple-willow cuttings in 10 hours. By strapping one handle of the pruners to a bench, in which a groove is cut to hold the lower jaw of the instrument, one man can accomplish almost as much as two. Where large quantities of cuttings are to be made each year, a special cutting machine, such as shown in figure 13, is desirable.

Cuttings can be made very rapidly by tying the rods tightly in bundles and sawing them. Unless very carefully done, however, the ends of the cuttings are likely to be torn or bruised, causing the tips to rot and preventing the ends from callousing. In making cuttings the aim should always be to have the ends clean and smooth, with their surfaces nearly at right angles to the axis of the rod.

STORING, PACKING, AND SHIPPING CUTTINGS.

Cuttings can be stored in a number of ways to insure their being in good condition at planting time. The chief consideration is to keep them from drying out. The ideal storage place is a room or cellar with a low, even temperature. Freezing does not injure the cuttings as long as they remain dormant, but may cause injury at any time after they show signs of growth. Repeated freezing and thawing should be avoided. Packing the cuttings in an upright position in moist sand, with a surplus of 2 or 3 inches over the tops, will keep them in first-class condition. They will callous properly if only partially covered with sand, though it is always advisable in such cases to cover the tops with burlap or sacking, especially if the temperature of the air is comparatively high. Soil, sawdust, ground cork, hay, straw, or leaves can be substituted for sand, though where material other than sand or soil is used there is some danger of heating, especially in warm, moist places.

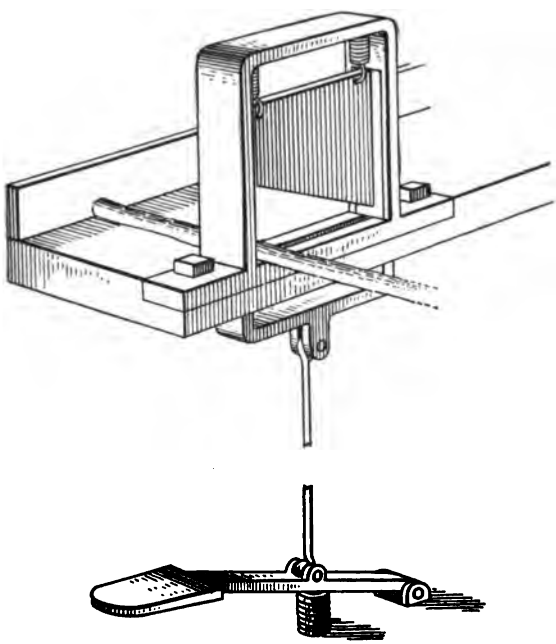


FIG. 13.—Machine for making willow cuttings.

The best time to pack cuttings for shipment is during cold weather. Practically half the failures in planting willow holts for the first time are due to the use of cuttings shipped late in the spring. Even if properly packed, cuttings will sprout vigorously within a few days after being removed from storage, if shipped during warm weather. Those packed tightly in very wet moss will produce tiny rootlets along their entire length, while those packed loosely, with moisture only at the ends, will produce young shoots. In either case, part of the vigor of the cuttings is lost, and they are also in a condition in which they may be easily injured.

A number of different materials can be used for packing. In cold weather a little dry hay or straw or slightly dampened moss is sufficient. Even in warm weather, if the cuttings have not yet shown signs of growth, it is better not to give them much moisture, since this hastens sprouting. If growth has started, however, it will be necessary to keep the cuttings somewhat moist, and for this purpose sphagnum moss is best. The moss should be thoroughly soaked and as much of the water squeezed out as possible. Lining a box or crate with burlap or oiled paper will aid greatly in keeping the cuttings in proper condition. Cuttings should be packed tightly together to prevent bruising, especially if the ends are calloused. Packing in sawdust or ground cork is recommended for shipping long distances in warm weather.

Cuttings shipped from a holt infected with insects or fungous diseases should first be sterilized. This should be done before the rods are cut up by dipping them for several minutes in a weak solution of formaldehyde. Another sterilizing solution is copper sulphate, 3 pounds; water, 50 gallons. This solution should be used before the buds have swelled and the ends of the cuttings calloused; otherwise, it may cause injury. Fumes of burning sulphur form another sterilizing agent, but should be used only when all growth is dormant. Still another is the modified "Eau Celeste":

Copper sulphate	pounds	4
Ammonia	pints	.3
Sal soda	pounds	5
Water to make	gallons	45

The rods should never be left in this solution more than 10 or 15 seconds, and afterwards should be so placed that the liquid will run off rapidly.

HOW TO PLANT.

The best time to plant is very early in the spring, when the weather is cool, the soil moist, and the cuttings show little if any growth. At this season of the year cuttings can be carried about the field in bundles and exposed to the air without danger of injury. If the cuttings have pushed out tiny rootlets, and the buds are bursting open at the upper nodes by the time planting begins, they should always be protected from the sun and air while being carried about the field. Placing them in buckets filled with water and covering them with wet sacks will serve the purpose.

Tools necessary for planting are very simple and easily made. Where only a few cuttings are to be planted, and the soil is soft, a sharpened stick can be used for making the holes, though a sharpened iron rod is better. This rod should be of three-eighths, one-half, or five-eighths inch material, depending upon the diameter of the cuttings to be planted. The point should be an abrupt rather than a long one, since otherwise a space will be opened up too narrow to permit the cutting to reach the bottom, thus creating an air space beneath the plant. The rod should be 3 feet long and bent at the upper end or, even better, have an 8-inch crosspiece welded on at the top. Where the soil is very rocky and hard, a crosspiece 1 foot from the sharpened end will allow the planter to force the rod down with his foot. The only other equipment necessary for planting is a cord on which are marked off the spacing distances.

When set in the holes cuttings should not protrude more than 2 inches above the surface of the ground. In all cases there should be one or perhaps two buds near or above the surface. As a general thing it is best to plant the cuttings in a vertical position, though foreign growers advocate a slanting one, on the ground that the cuttings root more freely. Experience in this country, however, has failed to confirm this belief.

The hole should be barely large enough to receive the cutting and never deeper than necessary. After the cuttings have been placed in position the soil should be firmly packed about them by the heel of the planter, care being taken not to bruise or break them. In a soil filled with springy, undecayed roots packing is best done with a tamper. Planting should be done soon after the holes are made, otherwise the latter are apt to dry out or fill up with loose soil.

SPACING.

The right spacing for a willow holt needs to be carefully considered. Close spacing produces a better quality of rod and insures greater yields per acre, especially for the first few years. For any of the varieties of American green close spacing can be unreservedly recommended under all conditions. Once well established, a close-spaced holt will virtually keep the weeds in check or crowd them out altogether. Under such conditions little or no cultivation is necessary, and in the case of American green there is little danger that the rods will become stunted. On fertile soils, in fact, this species, unless closely spaced, tends to produce rods that are too long, and which lack somewhat in toughness. (See fig. 14.)

With the purple and Lemley varieties close spacing, although it has often been recommended, presents serious disadvantages. Both of these species at the end of 6 or 8 years show a decided tendency to produce short rods, a characteristic which is greatly intensified in a closely spaced holt. On fertile, loose, sandy soil this tendency may not become evident for from 10 to 20 years, or even longer, but on heavy, clay soils the rods become stunted very early in the life of the holt. Purple willow, even when closely spaced, will not produce enough shade to keep weeds in suppression, making cultivation necessary. In a closely spaced holt this must be done by hand. For this reason many growers have found that on soils of only average fertility a spacing for purple willow of 6 by 30, 9 by 30, or 12 by 30 inches gives the best results in the long run. The shoots produced with such spacing are somewhat crooked, but never badly branched. Purple willow holts with this spacing have maintained their productivity for from 15 to 25 years, while in closely spaced holts on the same soil the rods have become very short in half this time.

The Lemley and patent Lemley, on account of their tendency to branch badly when open spaced and their ability to shade the ground

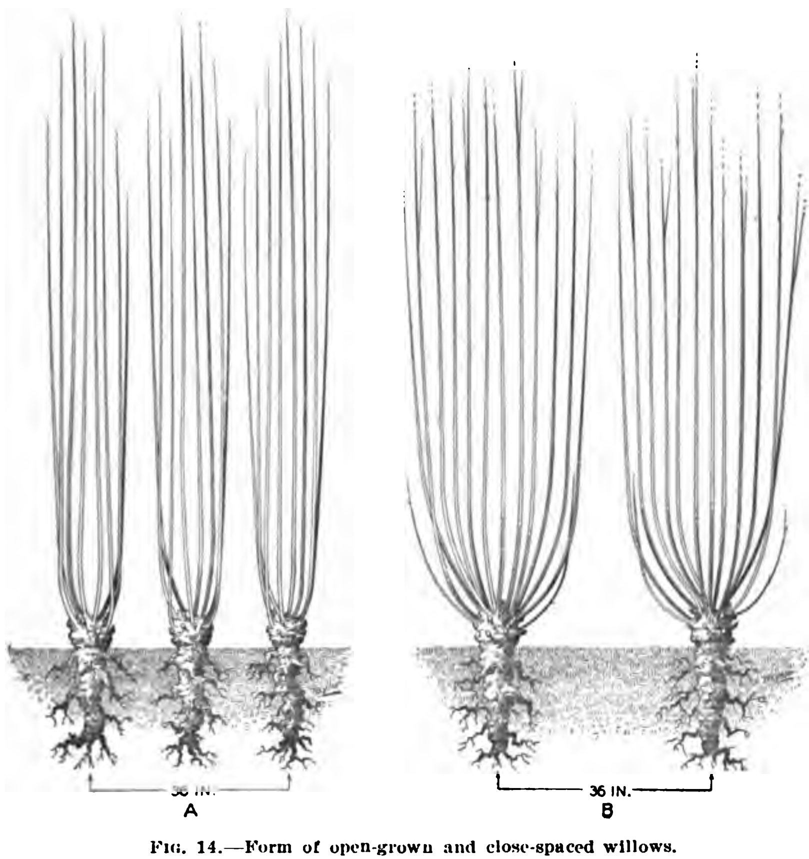


FIG. 14.—Form of open-grown and close-spaced willows.

when closely spaced, should be closely planted on all but the very poorest soils. If a holt of Lemley or patent Lemley becomes too crowded, the weaker plants will die out, while the survivors make a thrifty growth. The same thing is true, even to a greater extent, of American green, but purple willow fails to thin itself, and the rods in a too closely spaced holt generally become stunted.

In the case of American green, differences in width of spacing have very little effect upon the length of rods produced. With the purple willow, on the other hand, a 12 by 36 inch spacing results in the production of much longer rods. In the case of both species the weight per plant is proportionate to the width of spacing. With American green the width of spacing has but little effect upon the total yield, but with purple willow the yield is much greater in open-spaced plots.

The results of experiments at Arlington and observations in the field indicate the spacings, shown in Table 5, as best for the species listed.

TABLE 5.—*Proper spacing for basket willows on rich, medium, and poor soil.*

Variety.	Rich soil.	Medium soil.	Poor soil.
	Inches.	*Inches.*	*Inches.*
American green	6 by 18	6 by 18	9 by 20
Patent Lemley	6 by 18	6 by 24	9 by 24
Lemley willow	6 by 18	6 by 24	9 by 24
Purple willow	6 by 18	12 by 24	12 by 36

CULTIVATION.

The basket willow must be kept free of weeds from the start. The first two years form the critical period in the life of a holt, since the young plants are not vigorous enough to keep down the weeds, even if closely spaced. If the willows are closely spaced, cultivation will have to be done with a hoe or, if carried on early in the spring, with a small garden cultivator. In open-spaced holts a horse cultivator can be used, although some handwork will be necessary.

Unless a grower is sure that he can give his patch at least one hoeing in the spring for the first two or three years, it is better to space the willows wide enough to permit horse cultivation, since a well-kept holt widely spaced will produce much better than a close-spaced holt in which weeds and grass have gained a foothold. This is especially true of the purple willow. In the case of American green, close spacing, with perhaps a little cultivation in the spring, will suppress the weeds. In holts which are not cultivated frequently the roots of the willows are near the surface of the soil, and are likely to be injured when the holt is cultivated. Cultivation should never be deeper than 2 or 3 inches, but must be thorough. The results of imperfect cultivation are scarcely noticeable two weeks after it has been given, but when thoroughly done the weeds will not begin to reappear until at the end of that time. In a holt where weeds, especially grass, have gained a foothold, it is better entirely to remove a thin layer of sod than to chop up the surface and leave it on the ground for the grass to take root again if wet weather follows. After a layer of sod is removed, the soil beneath should be loosened up somewhat, even at the expense of cutting a few roots. Only by such treatment can grasses be thoroughly eliminated from a holt when once firmly established. Frequent and regular inspection of the holt is necessary to discover and stamp out at once such pests as dodder, morning glory vines, and caterpillars.

A NEW SYSTEM OF CULTURE.

To insure the best success of a willow holt with the smallest cost of establishment the following practice is suggested: The willows should be widely spaced at first to permit of horse cultivation. Spacing might be 6 by 36 inches, or even 12 by 36 inches, according to the soil and moisture conditions. Horse cultivation can be given at any time during the first year, since the rods are then small. This does not keep the holt absolutely free from weeds, of course, but very little trouble is entailed in removing the weeds within the row with a hoe. During the second year the holt can be cultivated by horse, at least until late summer, while the willows will produce enough shade to keep down weeds in the row. In the spring following the second year, cuttings should be set between those already established and similarly spaced in the row. These later cuttings, however, must be 5 or 6 feet long in the case of American green, and from 3 to 5 feet long in the case of purple and Lemley, since they compete for light with the plants already established. If the holt has been kept clean up to this time, the cost of cultivation will not be large, even though it must be done by hand. Thorough cultivation before planting the new sets will save at least one hoeing. The new sets should be allowed to grow for two seasons before being cut back to the ground. This method is especially desirable for a large holt in localities where the cost of hand labor is high.

MULCHES.

Where weeds are especially troublesome mulches can often be used to advantage. They not only serve to check the growth of weeds but also prevent the surface soil from becoming hard and difficult to cultivate. At Arlington mulches of sand and stable manure were applied to sections of the holt after the entire holt had been hoed. When the holt was cultivated for the second time very few weeds had made their appearance in the area covered with sand, and those that had appeared were easily removed. Weeds were more numerous in the manured areas, but less so than where there was no mulch at all. They were removed with comparative ease, leaving the surface loose and dry, with poor chances for their further establishment. During the early part of the season the willows which received the mulch fell somewhat behind the others in height growth. Two weeks later, however, they had actually forged ahead.

Sand mulches can be placed on a holt at a cost of from $15 to $25 per acre, according to the accessibility of the mulch. Unless manures are well rotted there is a possibility of carrying to the holt a large amount of weed seed, which will offset the beneficial effects of the application.

Mulches also serve to prevent heaving of the young plants during the first year or two of growth. While it is often possible to push cuttings back into the ground, they are always slow to recover. The Lemley and patent Lemley are especially susceptible to this sort of injury.

FERTILIZERS.

The average willow holt, situated on bottom land, seldom needs fertilizers. If willows fail to produce rods of sufficient size, it is much more likely to be due to poor drainage or acidity or poor physical condition of the soil than to lack of plant food. Very alkaline soils, however, should be heavily manured before planting. Light, sandy soils which have been cropped for many years respond very quickly to the application of fertilizer by increased yields. The greater portion of such soils in the coastal plain region of New Jersey and Delaware needs fertilizing to produce basket willows in large quantities. Well-rotted barnyard manure is the most satisfactory material, since besides its value as a plant food it improves the physical condition of the land and acts as a mulch to keep out weeds and grass.

The soil of most holts, even if well plowed, is usually packed quite hard by the time planting is completed. At best only the surface is stirred each year by cultivation. Moreover, the soil of a holt may be subject to a period of drought, and so become more or less baked. The physical damage done the soil each year is apt to be cumulative, since there is little chance to restore it to the proper condition. In such cases it may easily become sour, a condition which seriously affects the yield. This can be remedied by the application of lime. Not more than a ton per acre should be applied in one season. Sour soils are also often the result of poor drainage, which can be improved by constructing a ditch or a tiled drain.

REPLANTING FAIL PLACES.

Individual plants are continually dying out in a willow holt as a result of physical injuries or disease. The percentage of loss for any one year is so small, however, that it is not likely to be noticed until the accumulated losses of several years make themselves evident. It may not be until the end of 10 or 12 years, when many holts show a tendency to decline, that the grower realizes that his holt is poorly stocked. Replants made at this time are slow to become productive. A cutting establishes itself in an old holt much more slowly than if planted on new ground simultaneously with the other cuttings. For this reason fail places should be planted up each year. Neither the amount of material needed nor the labor involved will be large. The long 2-year-old stocks of the replants at the end of the second season furnish the very best material for cuttings. They are straight, free from branches, and grow vigorously when planted.

The difficulty of establishing new plants in old holts is due to root crowding and lack of direct sunlight. To determine the effect of root crowding five rows of 1-foot American green-cuttings were planted beside a well-established plot of American green. The new plants were placed on the south side of the established ones, and a wire stretched along the edge of the old plot to further eliminate shading. Soil and moisture conditions being uniform, this left only root crowding to account for any differences in behavior of the young plants.

In row No. 1, which was 18 inches from the old plants, 63 per cent of the cuttings failed to survive the first year. In row No. 2, which was 36 inches away from the established willows, 23.5 per cent of the plants failed to survive, indicating the influence of root crowding, even with open sunlight, at this distance. In the three other rows the loss was 11, 12, and 10 per cent, respectively, indicating that at a distance of 4½ feet or more the influence of established plants is not felt. Similar observations in New Jersey on patent Lemley and Lemley gave almost identical results, but with purple willow the influence of the established plants is not evident beyond a distance of 3 feet.

In planting fail places within a holt it can be assumed that the effect of root crowding will be practically the same in the case of each new plant, and that differences in development by cuttings of various lengths are due primarily to the amount of shading they receive. To determine the size of cutting best adapted to withstand shading, American green willows were replanted with cuttings of different lengths. This willow was selected because its dense foliage makes it more difficult to replant than any other species. Fail places in a large holt, set out in 1904, were planted with 1, 3, 5, and 7 foot cuttings. The 1 and 3 foot cuttings were planted 10 inches deep, and the 5 and 7 foot cuttings from 14 to 15 inches deep. In all cases selected material was used.

The 5-foot and 7-foot cuttings established themselves very successfully, but the 3-foot cuttings did not do so well. The 1-foot cuttings failed completely. The 7-foot cuttings made a better growth than the 5-foot ones, but the difference was not enough to justify their use, except under the most unfavorable conditions, since they are subject to injury by wind-shaking, especially on sandy soils. Longer cuttings have from three to five times as much leaf surface as 1-foot cuttings, which, with their greater height, form their superiority.

Replants should be set out as soon as the holt is cut, in order to give them an early start. Replanting late in the spring is apt to result in almost total failure. If the new cuttings are planted after they have put out leaves, it is better to pull these off and allow others to take their place when the plants become rooted. The replants should be allowed to grow two years before cutting. Rods cut from 8 to 10 inches above ground after one season's growth produce thriftier plants the second year, but the high stool resulting from this practice is very undesirable. If the replants are left two years, and are very numerous, it is best to cut them back to the original size the second season; otherwise they may actually shade the old, established plants.

HARVESTING THE CROP.

WHEN TO CUT.

The time for cutting willows will be governed largely by the size of the holt and the amount of labor available. One thing to be borne in mind, however, is that the cutting should be finished before the buds begin to swell. Cutting late in the spring after growth has started almost invariably results in decreasing the vitality of the stools and consequently the size of the succeeding crop. It also retards the new growth, since sprout buds do not form, as a rule, until after the cutting is done. Willow rods that are to be steam peeled may be cut from the holt as soon as the leaves fall and the wood has matured. Rods which are to be sap peeled or used for cuttings should not be cut from the holt, as a rule, until December or January, unless storage facilities are available. Cutting shoots before they are fully mature tends to make them soft and brittle.

HOW TO CUT.

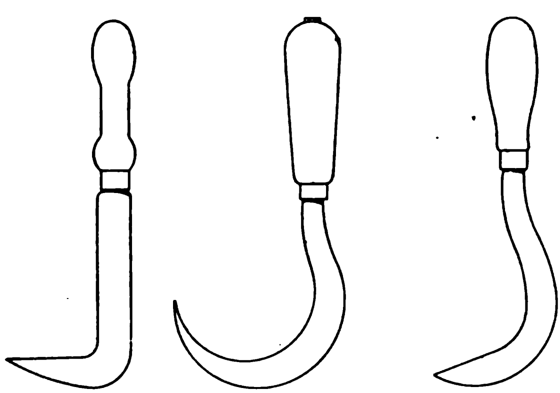
The best tool for cutting willows from the holt is the ordinary hook knife. This is made in many shapes and sizes (figs. 15, 16, and 17). For general use, however, where both large and small rods are to be cut, the shape shown in figure 15 is the best. The bulge at the end of the handle is a great help in keeping a firm grip. In cutting exceptionally large rods a leather thong attached to the handle and fitting over the hand or around the wrist will make cutting easier. Pruning shears, either small or large, are scarcely practicable for cutting willows where a quantity of rods is to be handled, since their operation consumes from one-third to one-half more time than cutting with a hook knife. Where the holt is so small that the time element need not be considered, pruners may be used to advantage, since they make it possible to cut the rods very close to the stool. Another case in which pruners are useful is with young plants which have been exposed to heaving during winter or which are being cut when the ground is soft. Under such conditions the upward stroke of the knife is likely to loosen the plant or actually to lift it from the ground.

The use of a scythe, brush hook, or hay or corn cutter is not advisable, since they leave the stools in a ragged condition and, as a rule, several inches too high.

Fig. 15.—Knife for cutting willows.

HEIGHT OF STOOLS.

Stools should be cut as low as possible. Where cutting is reasonably low, and the new growth is from the juncture of the shoot and the stool, the stump of the old shoot dies back, while the height of the stool is not appreciably increased. New growth from the collar is straighter than that from stumps of old shoots, since the latter are really lateral branches which must turn upward. Long sprout stumps are likely to have one or more lateral buds from which branches are sent out. The bases are thus kept alive, and the height of the stool much increased. Low-cut stools also offer the least chance for mechanical injury or disease.



A B C

Fig. 16.—Other forms of cutting knives.

COST OF CUTTING.

If the labor is carefully handled the cost of cutting rods from the holt can be kept within reasonable limits. Carelessness in this operation means a serious inroad upon the profits in willow growing.

The lowest cost figure for cutting on a large scale is probably that prevailing on a 45-acre holt in Michigan, where it amounts to $10 per acre. This small cost is made possible by the fact that the holt has a low yield, and is largely of purple willows. At Arlington it costs $7.68 per ton to cut purple willows. The average per acre yield in the Michigan holt is under 2 tons, so the cost of cutting per ton there is probably somewhere between $5 and $7. It is doubtful whether willows can be cut for less than $5 per ton green weight.

FIG. 17.—Cutting purple willows with the hook knife. The willows are held in one hand and cutting is done with the other. The rods are piled as they are cut.

BUNDLING AND PITTING.

Rods should not be left on the ground for any length of time after being cut, especially if the weather is dry and warm. They should be bundled according to size and shape. Straight rods are easier to handle, and can be tied in larger bundles. Rods which curve sharply at the base are more difficult to handle, since it is essential to keep the butts uniform, and so can best be tied up tightly in small bundles. Either binder twine or a willow rod can be used for tying. For a novice the cord is easier to handle, but an expert can tie up a bundle with a rod much more tightly and in less time than with twine. Purple willow rods are the best for this purpose.

After the leaves come out in the spring it is necessary to keep the cut willows in water until they are peeled. If out of water even for a day or two they die, and the bark can not be removed. A pit should be provided in which the water is of uniform depth and fluctuates as little as possible. The water in the pit should only be deep enough to be sure that the ends of all the rods are submerged. It is best to place the rods in a vertical position in the pit, for if they are allowed to lean, the butts on one side of the bundle are lifted and may be exposed to the air. Bundles pitted upright soon settle into the soft bottom of the pit, and after the rootlets have started there is little danger of their being overthrown by wind. It is a good plan to drop the bundle on the end several times before pitting in order to even up the butts (fig. 18).

The location of the pit will depend, of course, upon the available supply of water, but an effort should be made to have it where the willows will be protected from the wind and near a spot where peeling can be conveniently done. Provision should be made against the pit filling up to an undesirable depth during a freshet. If there is no running water near the holt, the surface run-off can often be used.

A shallow pit fed by a reservoir or pond is better than a deep one which fills up during a rain. A reservoir for a pit can often be made by merely throwing up a low bank of earth across a depression located somewhere above the pit. The water can then be let into the pit as needed. Deep mud or slime at the bottom of the pit should be avoided, since it discolors the base of the rods, although these portions under water are always somewhat discolored. It is seldom a good plan to pit rods in running streams, since it is hard to obtain a uniform depth of water, and there is always danger of the rods being carried away by freshets.

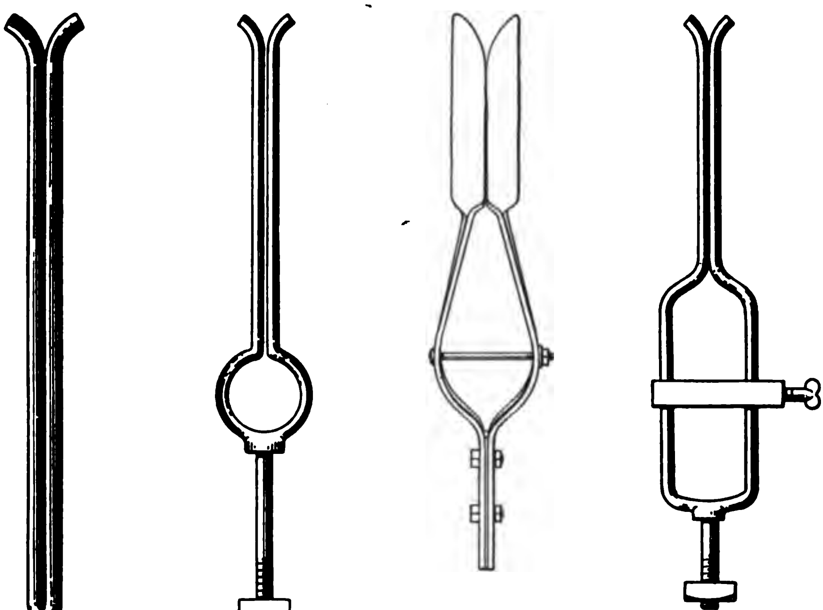
PEELING.

Hand peeling is done by drawing the rods between two steel plates or bars which have spring enough to break the bark, but not enough to crush the wood. These are made in a variety of forms, several of which are shown in figure 19. The one shown in figure 19, A, is easily made and gives good service. Figure 19, C, shows a very effective brake for peeling the Lemley willows which can be made from a wagon spring.

Peeling presents the most difficult problem in basket-willow culture in America, since it is always hard to secure labor at a cost which will allow a profit to the grower. At times it is almost impossible to get the necessary labor at any price. This condition has been responsible for the abandonment of many willow holts. The actual difficulties of peeling are comparatively few; it is the high cost of hand labor and the difficulty of securing it which handicaps the willow grower. What is needed is a peeling machine to cost not over a hundred dollars. Several good machines have, in fact, been designed, but those so far manufactured are, perhaps with one exception, very large and cumbersome, and can not be sold for less

FIG. 18.—Pitting American green willows.

than several hundred dollars. They have been designed, moreover, for peeling steamed willows rather than sap willows, which seems a mistake, since the latter will bring at least 2 cents more per pound and have a much more more extensive market. The use of the present machines by the average willow grower could be likened to the use of a large power corn sheller by farmers who raise only a few bushels per year. The basket-willow industry calls for a machine to parallel the small hand corn sheller now found on every farm where corn is a minor crop. A successful peeling machine of the kind described should have a large sale. Its appearance on the market would give a stimulus to willow growing, while every farmer with a willow patch could be sure that it would repay him for the time bestowed upon it. Willow growing would then become a common practice rather than the specialty of a few.



A B C D

FIG. 19.—Hand peeling devices.

It is unfortunate that steam peeling is so much practiced in this country. It tends not only to put the bulk of American-grown rods into the second class, but, through the necessary centralization which the practice entails, control of the willow industry in certain localities has come into the hands of a few dealers and out of those of the small grower and basket maker.

DRYING, DRAFTING, AND BUNDLING.

Peeled willow rods should be thoroughly dried before bundling. One or two days in the hot sun will suffice for this, if the rods are well spread out on racks. They should be kept out of the rain, and covered at night to protect them from the dew. Otherwise they lose their whiteness.

Rods are often drafted, or sorted, as soon as they are cut from the holt, but it is better if they are fairly uniform in size to sort them while peeling. With a little practice a peeler can divide the rods into several piles, according to size, without the expenditure of extra time and with very little additional labor. (Figs. 20 and 21.)

Where there are a large number of rods, bundling should be done by a machine. (Fig. 22.) Willows well sorted and bundled are much more salable than those which have been poorly prepared for the market. Rods which have a decided curve at the base, like the Lemley, should be bound with the ends pointing uniformly in one

FIG. 20.—Drafting basket willows.

direction. This results in a much neater and more compact bundle, and also permits of better stacking.

RETURNS FROM WILLOW GROWING.

The cost of establishing and preparing a basket-willow holt varies much more than in the case of the ordinary farm crop; consequently there is also a wide variation in the net returns per acre. The one thing to keep in mind in willow growing is that a poorly managed holt, even if well situated, will not pay, while a well-managed holt, even under less favorable conditions, will return a good profit. Willow growing requires a certain amount of exact knowledge, and for this reason the costs for the beginner are generally higher than for the experienced grower. The following tables show the average returns from steam-peeled purple willows and sap-peeled American

FIG. 21.—Drying the peeled rods.

FIG. 22.—Bundling the peeled rods.

green willows. In arriving at the figures given, average conditions of soil and moisture were assumed. It was also assumed that the holts are moderately well managed. While the cost figures may be too high for some individual holts, they represent the costs that an average grower will have to meet.

TABLE 6.—*Returns from steam-peeled purple willows, spaced 12 by 36 inches, land valued at $35 per acre.*

FIRST YEAR.

Expenses.		Returns.	
Preparation of land	$10.00	Sale of green rods, 1 ton, at $20	$20.00
Cost of sets	15.00	Expenses	43.35
Planting	6.25		
Cultivation (horse)	3.00		
Cutting, at $5 per ton	5.00		
Interest on land, cash investment, and taxes	4.10		
	43.35	Net loss	23.35

SECOND YEAR.

Cultivation	$6.00	Sale of green rods, 2½ tons, at $20	$50.00
Replanting fail places	1.50	Expenses	23.25
Cutting, at $5 per ton	12.50		
Interest, taxes, etc	3.25		
	23.25	Net profit	26.75

THIRD YEAR.

Cultivation	$8.00	Sale of green rods, 4 tons, at $20	$80.00
Replanting fail places	.75	Expenses	35.85
Cutting at $5 per ton	20.00		
Spraying	5.00		
Interest, taxes, etc	2.10		
	35.85	Net profit	44.15

FOURTH TO FIFTEENTH YEAR.

Cultivation	$12.00	Dry peeled rods, 5,333 pounds, at 6 cents	$319.98
Replanting	1.50	Annual expense	217.92
Cutting	40.00		
Peeling	133.32		
Drafting	24.00		
Spraying	5.00		
Interest, taxes, etc	2.10		
	217.92	Annual net profit	102.06

The net profit for 15 years would then be $1,295.31 or an average annual net profit of $84.82 per acre per year.

TABLE 7.—*Returns from sap-peeled American green willows, spaced 9 by 20 inches, cuttings purchased, land valued at $35 per acre.*

FIRST YEAR.

Expenses.		Returns.	
Preparation of land	$12.00	Dry peeled rods, 1,000 pounds, at 6 cents	$60.00
Cost of sets	52.50	Expenses	136.55
Planting	12.50		
Cultivation	15.00		
Cutting, at $5 per ton	7.50		
Peeling, 2½ cents per pound, dry rods	25.00		
Drafting, at $3 per ton	4.50		
Interest, taxes, etc	7.55		
Total	136.55	Net loss	76.55

SECOND YEAR.

Cultivation	$15.00	Dry peeled rods, 3,000 pounds, at 6 cents	$180.00
Replanting	1.50	Expenses	133.42
Cutting, at $5 per ton	22.50		
Peeling, at 2½ cents per pound, dry rods	75.00		
Drafting	13.50		
Interest, taxes, etc	5.92		
	133.42	Net profit	46.50

THIRD YEAR.

Cultivation	$12.00	Dry peeled rods, 5,333 pounds, at 6 cents	$319.98
Replanting	1.50	Expenses	219.42
Cutting	40.00		
Peeling	133.32		
Drafting	24.00		
Spraying	5.00		
Interest, taxes, etc	3.60		
	219.42	Net profit	100.56

From the fourth to the twentieth year of the holt the average annual net profit should be $100.56. The average annual net profit per acre for the 20 years is, therefore, $89.

MARKETS AND MANUFACTURE.[1]

In Europe every grade of basket, from the finest to the coarsest, is made of willow. The heaviest farm baskets and receptacles for handling rough merchandise are made out of unpeeled rods, while peeled rods go into market, clothes, and fruit baskets, furniture, hampers, and trunks. In Europe, too, the finest examples of split willow ware have been developed.

In America the market has a different aspect. A large number of baskets are made of wood, some of woven pine, oak, ash, and elm strips; others from broad veneers laid together at the bottom and fastened at the rim by a strip. Wood goes into market, clothes, and laundry baskets, and willow is forced to be content with a limited share of the general trade. Reed and rattan, too, have a permanent place in the American market.

Though willow is less easy to work than rattan, its durability, lightness, and beautiful color have brought it into favor with manufacturers of furniture, several of whom have given up rattan entirely in favor of willow. To-day there is a steady demand for willow furniture, where light, attractive, and durable goods are desired (fig. 23).

The willow-furniture industry in America is centered in New York, Boston, and Rochester. Small concerns are located in other places, but most of the wholesale supplies come from large houses in the three cities named. The extension of the industry is limited not so much by the lack of raw material, though in some cases there is such a lack, as by the scarcity of skilled workmen. At present all manu-

[1] Revision of material contained in Forest Service Bulletin 46, "The Basket Willow," by W. F. Hubbard.

facturers use far more imported willow than they do American, because the imported willow rods are better sorted and easier to get in small sizes. The average American grower does not seem to appreciate the value of small stock, which is more difficult to peel, and consequently more expensive to produce.

Imported willow rods sell, on an average, for about 7 cents per pound. The best quality of American-grown willow comes in four sizes and sells at from 5 to 7 cents a pound. The smallest size is hard to get, and the other sizes are seldom well sorted. The American-

FIG. 23.—A well-made willow chair.

grown willow is regarded favorably by furniture makers, and whatever objections they may have can be removed by greater care in culture and in preparing the rods for the market.

The makers of high-grade willow basket ware (fig. 24) are generally located in the larger cities throughout the North and in the Mississippi Valley. There are also several establishments in San Francisco and Sacramento. In the South basket makers are found only in Richmond, Charleston, and New Orleans. Practically no attempt is made by any of these manufacturers to compete with makers of cheap baskets.

In the East both foreign and domestic willows are used. Even in this section, however, the manufacturers say that they would use more American-grown willows if they could get them, since they are heavier and more durable than the French. All willow used for fine baskets and for furniture must be a brilliant white, and for this reason only sap-peeled rods are considered. In the Middle West and West transportation costs increase the price of foreign-grown willows and limit their use. All the manufacturers seem to prefer the American-grown willow if it can be obtained.

Upon the manufacturer of low-grade basket ware falls the burden of the competition with wooden baskets and with cheap willow prod-

FIG. 24.—High-grade willow ware.

ucts imported from Europe. The manufacture of low-grade baskets is centered in western New York and in the larger cities throughout the country. The basket-willow industry about Syracuse, Rochester, and other points in western New York differs from that in any other part of America, more nearly approaching the industry in certain sections of Europe. It is carried on in the midst of an important willow-growing district, and is mainly in the hands of a few large dealers who buy the willows and give them out to basket makers. These latter work at home, receiving a specified sum per dozen for the baskets, according to the size. The willows are steam peeled, a process which turns the rods a red-brown color and ruins them for all fine work. Besides the industry in western New York, willow-basket makers are scattered through the country districts of Pennsylvania and the middle western States as far as the Mississippi. Conditions are very much the same as those in New York, though, as a rule, sap-peeled willows are used.

SUGGESTIONS FOR BASKET MAKERS.

In Europe basket ware is used for many purposes practically unknown in this country. In bakeries and dairies, on the Continent and in England, eggs, buns, rolls, etc., are displayed in very delicately woven, shallow baskets of the best quality, which add a real attractiveness to the store. Grocers often use willow hampers for dried fruits, nuts, etc. Such hampers are made with one side higher than the opposite one, so that the wares can be better seen. The hamper is set on short feet.

In England great quantities of split basket ware are used. Screen doors and even office window screens are beautifully fashioned in willow, and even hotel washstand splashers are made of willow. Small mats for hot dishes at table are also made of split willow, as are also very dainty bread baskets. A half-bushel basket is made in England and Holland which is singularly durable for its weight. The bottom is arched, giving the whole basket great strength. Nurserymen ship their trees in baskets of unpeeled willow, the uprights of which project and are tied over the top of the plant for its protection. A very beautiful and light basket is made in Germany, with the lines formed simply of uprights, strengthened with one or two lines of weaving.

In England commercial travelers' sample boxes are made of willow, the corners and edges being bound with rawhide. These boxes or trunks are very light, and will stand almost any kind of usage. Parcel trunks on the English railways are almost always of willow, and seem to give the best service. Willow trunks and hampers are a feature of railway traffic, and their use, especially in suburban service, might become more general in this country.

EXPERIMENTAL PLOTS.

Very little attention has been given in America to keeping up the quality of the willow stock, though the basket willow to-day is the result of a long selection. More growers of willows on a large scale should maintain an experimental holt, in which new varieties can be tried out, and selections from the heaviest-yielding and best-formed plants used as planting stock. Reproducing willows by seedlings seems to increase the vigor of the plants, and experiments in this line also can be carried on. Such experimental work breaks up a variety of willows into several groups of individuals with similar general characteristics which form a basis for still further selection.

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FARMERS' BULLETIN

623

Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.

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ICE HOUSES AND THE USE OF ICE ON THE DAIRY FARM.

By JOHN T. BOWEN, *Technologist*, and GUY M. LAMBERT, *Dairyman*, *Dairy Division*.

INTRODUCTION.

The principles involved in the proper care of milk and cream are very simple and easily understood. Notwithstanding this fact, much of the product delivered to creameries is improperly cared for and therefore is unfit to be made into butter. One of the most common causes of poor quality of butter is the lack of immediate, thorough cooling of the cream after separation. The Dairy Division has made a careful investigation of conditions existing on a large number of dairy farms where first-class cream is produced, and the data obtained show that, if properly cooled, cream of the best grade can be produced with but little extra labor or expense.

Dairymen in certain parts of New England are delivering practically all their product to the creameries while sweet, although the cream is often held on the farm from one to four days in summer and from one to seven days in winter. After it reaches the creamery it is pasteurized and shipped a distance of from 50 to 300 miles, where it is sold in the form of sweet cream. These results are accomplished by the liberal use of ice, nearly every farmer having stored large quantities in the winter for use in cooling milk and cream the following summer. These dairymen realize the importance of the use of ice and provide themselves with a suitable supply. They have followed this practice for several years, and most of them have provided a convenient source of supply, suitable houses for storing, and ice-water tanks for the immediate cooling of the milk or cream.

The expense connected with the liberal use of ice in this respect is so small and the results so satisfactory that the following data have been compiled for the consideration and benefit of those interested

NOTE.—The use of ice on the dairy farm for the keeping of milk and cream in the best marketable condition is discussed in this bulletin. Plans and specifications for ice houses are given. The bulletin is applicable to dairy sections where natural ice is obtainable.

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in dairying who have not had the opportunity to observe the advantages and profits to be derived from the use of ice on the farm. The variety of conditions shown and described in this paper will undoubtedly make it possible for the average dairyman in those States where natural ice is produced to select some plan or style that will meet his requirements at a reasonable cost.

COOLING MILK AND CREAM ON THE FARM.

Some creameries accept any kind of cream without regard to its condition when delivered, and they usually pay the same price for all grades of cream. In some dairy sections noted for the high quality of butter produced, the operators of creameries have found that in order to get the highest market price for their butter it is necessary to demand a good, clean, raw product, and they are now grading all cream and paying on a quality basis. As a result the producers are studying the situation more closely, as they realize that they must provide better facilities in caring for their product. Many creamery patrons who deliver sweet cream object to having it mixed with cream of inferior grades, so they find it to their advantage to deliver the product in individual cans.

During the summer months it is seldom possible to find ordinary well water which will cool milk and cream even to as low a temperature as 50° F. It is apparent, then, that some form of special cooling should be provided for this purpose; and as the natural cooling mediums are air and water, their capacities for absorbing heat will be compared.

The temperature of the air is usually too high for cooling milk and cream; consequently it becomes necessary to lower its temperature by bringing it into contact with some body colder than itself. Ice is generally used for this purpose on the farm. There are, however, the disadvantages that the circulation of the air is very slow and that its capacity for absorbing heat is very small. The specific heat of air is only 0.0177 per cubic foot; hence 53.6 cubic feet rising 1° in temperature are required to absorb sufficient heat to lower 1 pound of milk 1°.

The air, of course, must be brought in contact with the surface of the cans containing the milk, and unless provision is made for forcing a current over the cans the cooling will depend chiefly on the natural circulation, which is brought about by the difference in temperature between the comparatively warm air near the cans and the surrounding cold air. As the air in direct contact with the cans is warmed it rises, while the cold air in contact with the ice falls; hence the velocity of circulation depends upon the difference in weight of the respective columns of air, and as this difference in weight is very little, the circulation is slow.

When a can of milk is set into a tank of water to cool, the circulation is on the same principle as that of air, but the natural circulation of water takes place at an even slower rate than that of air. Water being one of the hardest of all substances to heat, its specific heat is taken as unity. Therefore, the specific heat of other substance is usually less than 1. As the specific heat of water is taken at 1, the raising of the temperature of 0.0152 cubic foot, or 0.95 of a pound, of water 1° will lower the temperature of 1 pound of milk 1°. In other words, 1 cubic foot of water rising 1° will absorb as much heat as 3,520 cubic feet of air for the same rise in temperature.

The time required to cool milk by placing the cans in moving water is less than when the water remains still, and the difference between the time required in cooling when the cans are placed in moving

FIG. 1.—A good type of zinc-lined wooden ice-water tank.

water and in still air and moving air is even greater. Taking 1 as the time required to cool milk in moving water through a given range, the time required for the same operation when the cooling is brought about by placing the containers in still water, in still air, and in moving air is 1:1.2, 1:1.5, and 1:3, respectively. By moving air is meant an air blast from a fan, and the time of cooling will vary with the velocity of the air. The initial temperatures of the air and water are assumed to be the same. In either case if the milk is agitated the cooling goes on much faster.[1]

Unless good insulation is used and precautions are taken, it is not probable that the air in an ice-cooled refrigerator will remain much below 50° F. On the other hand, it appears that the temperature

[1] For further information on the cooling of milk by placing the can in moving water see Bulletin 98 of the United States Department of Agriculture.

of water in which the ice is constantly floated will usually remain as low as 40° F., and in many cases lower.

For the purpose of securing information from actual conditions, ice-water tanks of many different kinds and shapes, some with and some without insulation and tight-fitting covers, were examined on more than 60 farms. The average temperature of milk and cream which was held in these tanks was about 40° F., and in each instance the cream was sweet. The cost of these ice-water tanks varied from $5 to $20, depending on the size and whether the tank was made or was purchased from some supply house. There are very few farmers

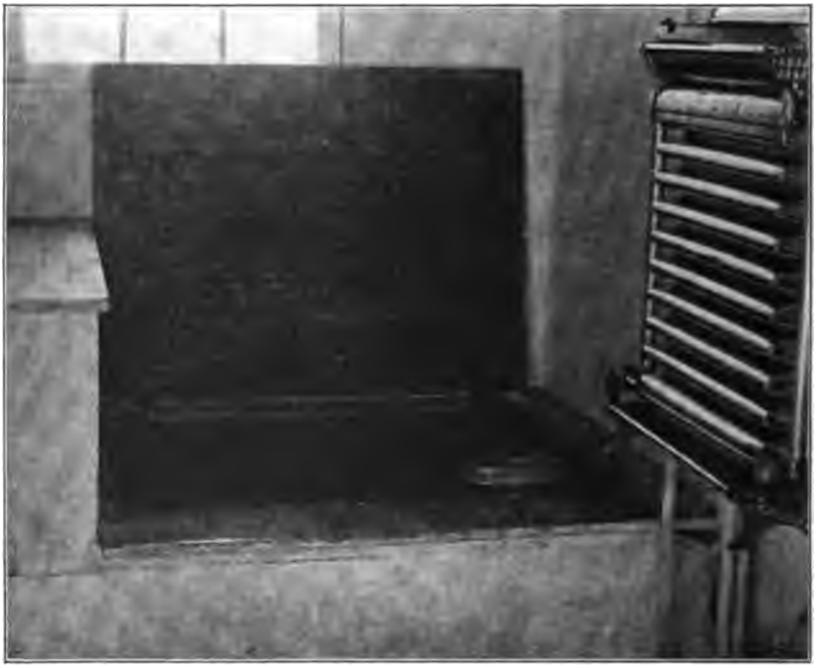


FIG. 2.—An inexpensive concrete ice-water tank.

who can not afford to provide themselves with some form of ice-water tank which will conform to their own ideas and the local conditions.

A great many different styles of tanks are in use. Figure 1 shows a type of ice-water tank which has proved satisfactory. This style has double wooden walls and is lined with galvanized iron. It is also provided with two air spaces and two covers. With a little time, labor, and expense such a tank can be made on almost any farm. A can of cream placed in ice water in such a tank will remain sweet for several days. Many less expensive tanks were found in use that gave desired results.

Figure 2 is an illustration of a concrete tank which every farmer can construct at a small expense and which will answer most purposes.

Figure 3 is a photograph of a load of 2,160 pounds of sweet cream which had been gathered from 39 patrons over a route 24 miles long. The picture was taken on a Saturday morning when the outdoor temperature was 92° F. Some of the cream had been held from the previous Wednesday evening. At the time of delivery to the creamery the temperature of the cream varied from 55° to 60° F. Had the cans been jacketed this temperature would have been even lower.[1] If this load of cream had been old and sour and delivered subject

FIG. 3.—A load of cream that had been properly cooled by the use of ice water and remained sweet after a long haul in hot weather.

to a 4-cent premium per pound for butter fat in sweet cream, the loss on the load on a basis of 25 per cent fat would have amounted to $21.60. On the other hand, the ice used to cool the cream on the farm added very little to the cost of production.

THE COST OF ICE.

The cost of packed ice will vary according to the local conditions under which it is harvested, these conditions of necessity differing in almost every case. Our investigations show that ice has been cut at a price as low as 1 cent for a cake of 220 pounds, making the ice

[1] See Bulletin 98, United States Department of Agriculture, for data on jacketed and unjacketed cans.

cost, exclusive of hauling and packing, 9 cents a ton. The usual price, however, was found to average about 2 cents a cake, or 18 cents a ton. To find the total cost of storing ice, the charge for hauling and packing must be added; this brought the average to about $1 a ton. In some instances the original cost of the ice and the packing amounted to $2 a ton, but in these cases the storage houses were at long distances from the pond.

We wish to emphasize the fact that these results were not obtained under exceptional conditions, and it is safe to assume that the cost as stated above would be about the same in a large number of localities throughout the States in which natural ice can be produced. By taking the figures in the following table as a basis for calculation, it is possible to estimate the cost of harvesting and storing natural ice on the average farm. One cubic foot of solid ice weighs about 57 pounds. Considering this weight as the standard, and allowing for packing, 1 ton of ice will occupy approximately 40 cubic feet.

A table for estimating the number of cakes of various thicknesses required per ton of ice (size of cake, 22 by 22 inches).

Thickness of ice.	Number of cakes required per ton.	Cutting space required per ton.
Inches.		*Square feet.*
4	31.3	105.4
6	20.9	70.2
8	15.6	52.6
10	12.5	42.1
12	10.4	35.1
14	8.9	30.1
16	7.8	26.3
18	6.9	23.4
20	6.3	21.1
22	5.7	19.1

HARVESTING ICE.

Farmers who have a comparatively small quantity of ice to harvest will find that they need for equipment only two saws, two ice tongs, two ice hooks, and a pointed bar. Many farmers have found it very profitable to cooperate with three or four neighbors in filling their ice houses. In such instances each individual may use his own tools, or the complete outfit may belong to a cooperative association.

In marking the ice, a long plank may be used as a straightedge, or it may be used to guide the handsaw. In cases where a horse plow is employed, the attached gauge will serve to keep the additional lines straight. The advisability of cutting square or oblong cakes must be decided by the harvester. In compiling the foregoing table square cakes 22 by 22 inches were used merely because our investigations showed that the majority of farmers were storing cakes of that size.

After the ice cakes are broken apart, two men with ice tongs can with little difficulty pull a cake of ice from the water and load it on a wagon or sled. If desired, a slide and a table platform may be used and a horse employed for drawing the cakes from the water on to the platform, from which they may be easily loaded.

QUANTITY OF ICE REQUIRED.

Before building an ice house of any kind, the quantity of ice to be stored should be determined. The quantity needed for cooling purposes will necessarily vary according to the local conditions and can not in all cases be definitely stated, though it may be calculated approximately. After studying the conditions on a large number of farms and securing figures regarding the amount of ice used for cooling and keeping milk and cream in a sweet condition for from one to four days, the following facts were established:

(1) Ice-water tanks were in general used for cooling milk and cream.

(2) The quantity of milk or cream cooled in this manner varied in individual cases from 21 pounds to 336 pounds per day.

(3) The temperature of the milk and cream being held in such tanks averaged about 40° F.

(4) In each case a cake of ice was found floating in the water; which showed that there was a constant supply of ice in the tank.

(5) A total of 5,142 pounds of cream required approximately 6,020 pounds of ice per day, or an average of 1.16 pounds of ice per pound of cream to cool and hold until delivered.

These figures were secured from actual conditions and covered a period of six weeks, in which the temperature outdoors varied from 56° to 100° F.

Owing to the different conditions under which ice is handled, the location of the buildings in reference to protection and the quantity of ice packed, it is not surprising to note a large variation in shrinkage. In an examination of more than 100 farmers' ice houses the shrinkage was found to vary from 20 to 50 per cent, with an average of 27 per cent.

If the average cow produces 3,500 pounds of 3.7 per cent milk in a year, which is equal to 431 pounds of 30 per cent cream, it will require, according to the above figures, 431 times 1.16 pounds, or approximately 500 pounds of ice, to cool the cream produced by one cow and keep it in a good, sweet condition until delivered to the creamery. In addition to this amount, it will usually be advisable to store 500 pounds of additional ice, thus making a total of 1,000 pounds per cow. This amount is sufficient to cool the cream needed for household use and allow for reasonable waste. Therefore, on this basis a 20-cow dairy will require 10 tons of ice for cooling the cream.

These figures are for cooling cream; if whole milk is cooled, considerably more ice will be required. Under average conditions it will take from two and a half to three times as much ice to cool the whole milk from 20 cows as it will to cool the cream from the same herd. Generally speaking, in the North it will take 1½ tons of ice for cooling the milk for each cow, and 2 tons per cow in the South. From 40 to 50 cubic feet are required for a ton of packed ice, consequently for 10 tons about 500 cubic feet of space will be necessary. As the amount of heat leakage will in a great measure be proportional to the exposed outside surface area of the house, it will be logical, from a business standpoint, to build a house that will approach as nearly as possible a cube in shape. In addition to the space 10 by 10 by 5 feet required for the 10 tons of ice, at least 12 inches should be allowed on each side and bottom for sawdust or other packing material, and at least 3 or 4 feet on top to allow space for packing and ventilation; consequently a 10-ton house should be built 12 by 12 by 8 feet.

THE FARMER'S ICE HOUSE.

It is our purpose to discuss only the different types of ice houses found in actual use, so that the dairyman may have an opportunity to study the advantages of each type and select the one best suited to his needs. Only a small number of the ice houses examined were built of new lumber. In many instances ice was stored in the cellar under the house or barn, or in the corner of some building, such as a woodshed, corncrib, or barn, or under the driveway leading to the barn, and occasionally it was simply stacked outdoors with no roof for protection. Where the ice was stored in cellars, open sheds, or in stacks, the loss from melting was comparatively large, depending on the ventilation, drainage, and care in packing. Where the cost of harvesting ice is a small item, dairymen often say that it is less expensive to store ice in such places than to go to the expense of building an up-to-date ice house. Where ice is simply stacked outdoors and covered with some form of insulation, it is necessary to put up from 30 to 50 per cent more than the amount previously allowed, so as to provide for the heavy shrinkage.

The ice should be stored as near the milk house as possible, in order to save labor in removing it to the milk tank. A great many dairymen find it an advantage to have the milk room in one end of the ice house, as in figure 4. In this way the cost of a separate tank house is eliminated. The small amount of time and labor required to transfer the ice to the cooling tank generally acts as an added incentive for the free use of ice. It is highly important that the milk room, whether combined with the ice house or standing alone, be located so that objectionable odors will be avoided.

In comparing the different methods of storing ice, it was found that where the cost of ice was comparatively high it was advisable to spend enough money in building and insulating the ice house to protect the ice from melting as much as possible, but in cases where the cost of the ice was small it appeared that the owners were often justified in building a cheaper storage with a relatively high loss of ice from meltage. The dairyman therefore should consider both the cost of construction and the cost of the ice in selecting the type most suitable for his requirements.

Some farmers store their ice in roughly constructed bins. One of this sort was seen, made by placing large posts of irregular sizes 3 feet in the ground and about 4 feet apart, and upon these were

FIG. 4.—Farmer's ice house with milk room.

nailed a miscellaneous lot of boards; no roof whatever was provided. The shrinkage was reported to be from 30 to 50 per cent. Ice might be stored in this manner for some purposes, but this method is not recommended for a dairy farm. Furthermore a bin of this sort is very unsightly and is an indication of slack methods in farming. Where ice is cheap and building material high, it might be permissible as a temporary arrangement; but it is not so economical a method as may appear at first sight, for the cost of the ice lost in the shrinkage would generally amount to more than the interest on the cost of constructing a serviceable ice house.

An instance was observed in which a corner of a woodshed, about 12 feet square and 10 feet high, had been converted into an ice shed. This corner of the woodshed had been roughly boarded up and about 14 inches of sawdust placed around the ice on all sides, top, and bottom. The cost of the building was very little and the shrinkage was reported at about 20 per cent. The owner stated that softwood sawdust is a much better insulator than hardwood sawdust.

The ice house in figure 4 measures 15 by 20 feet on the outside and is 8 feet high. At the front or south end a room 15 by 6 feet is partitioned off and used for a milk room. The remaining space, 15 by 14 feet by 8 feet high, after allowing for 6 inches of wall, 12 inches of sawdust on the sides, 12 inches on the bottom, and 18 inches on the top, will provide space for about 17 tons of ice. This house is built on high, sloping ground where the soil is porous; consequently the drainage is satisfactory. The foundation is made of concrete (mixture, 1 to 6), 1½ feet wide at the bottom and sloping gradually until the top measures 8 inches. The sills which rest on the foundation are 6 by 6 inches, upon which are erected 2 by 6 inch studding with 24-inch centers. On the top of the studding rests a 2 by 6 inch plate, and the studs are sheathed inside and outside with rough boarding. The outside is then covered with weatherboarding. The roof has a two-thirds pitch and is constructed of 2 by 4 inch rafters, 24-inch centers, boarded and covered with shingles. In each gable is located a slat ventilator, 2½ by 1½ feet, which with the high pitch of the roof allows for an abundance of free circulation of air over the ice. The milk room is provided with two glass windows 3½ by 2 feet, one in each end. The milk room is provided only with a movable ice-water tank, 3½ by 4 by 3 feet, in which are placed the cream cans. A rope and pulley which are fastened to the ceiling are used in transferring the ice from the ice house up and over the wall and lowering it into the tank. The material and labor for constructing this combination milk and ice house amounted to $125. The shrinkage on the 100 cakes in storage was estimated at about 15 to 20 per cent. The ice in this house cost 2 cents a cake, exclusive of hauling and storing.

ICE-HOUSE CONSTRUCTION.

The details of ice-house construction depend to a great extent on local conditions, size of house, and the difficulty of obtaining ice. These factors govern the amount of money that is practicable and desirable to put into such a building. Where ice is expensive or difficult to obtain, a better constructed and insulated house is advisable. In some States where natural ice is plentiful and can be cheaply harvested and stored, it appears that the cheapest structure possible has been considered satisfactory, and the question of the ice melting has been given very little thought. In most cases, also, it appeared that better results could have been obtained with the same expenditure of time and money if more attention had been given to the construction and workmanship.

Generally the construction of an ice house is a question of economy. The cost of harvesting and storing, interest on the money invested, repairs, and depreciation on the building should offset the saving in the melting of ice; beyond this it is not good policy to go.

Some typical designs of farm ice houses have been prepared; and while there is a difference of opinion among men of experience as to the exact details in the construction of such buildings, it is believed that if the instructions and designs given herein are followed satisfactory results will be obtained.

The location of the house should be such as to shield it as much as possible from the wind and from the direct rays of the sun.

INSULATION.

The function of an ice house is to prevent the outside heat from passing into the interior and melting the ice; therefore the problem is to minimize the passage of heat by interposing in the walls a material or a construction which will resist its transfer from the outer to the inner side of the building. There is no material known that will entirely prevent the passage of heat; however, there are materials which offer a high resistance and are termed nonconductors or insulators. The best insulators appear to be those that contain the greatest amount of entrapped air confined in the smallest possible spaces. Formerly it was the practice in constructing buildings for the storage of ice or for cold-storage purposes to provide a series of air spaces some of which were as much as 12 inches wide, the supposition being that they were dead-air spaces. As a matter of fact, however, as the air in contact with the cooler surface fell while that in contact with the warmer surface rose, it produced a circulation tending to equalize the temperature of the sides of the air space. Therefore an air space 1 inch wide is practically as good as one 12 inches wide. Air circulation is valuable, however, between the insulated ceiling and the roof of an ice house in order to break up the heat radiation through the roof.

No entrance or exit of air should be allowed to take place in a room where ice is stored, especially at or near the ground line, as the cold currents of air at the bottom will filter through. If the walls and foundations are kept absolutely tight at the bottom, an opening at the top has but little effect, as the warm air entering will remain at the top of the room. When it is necessary to remove ice from the house, the door should be kept open as short a time as possible, and where a covering material is used the ice should be carefully covered. In a properly insulated house a great advantage is that no covering is required. The ice is packed on the floor of the room, depending on the insulated walls and floor for protection from the outside heat. But in the cheaper houses it is better to cover the ice with some material, such as sawdust or mill shavings. A layer of the insulating material should be placed directly on the floor and the ice stacked thereon; there should also be a layer packed between the ice and the walls. Ice should never be placed directly on the ground, soil being a fairly good conductor of heat, especially when wet, as the floors of all ice houses are sure to be. The larger percentage of waste, however, is due to the entrance of heat through the insulation of the walls and floor; consequently they should be carefully constructed.

As sawdust and shavings are shown in some of the typical designs, it is not to be understood that they are the best insulators for this class of buildings. They are used because they are cheap and can be had in any part of the country, and if kept dry are good insulators. It is a very difficult problem, however, to keep them dry, and when they are to be used great care should be exercised in the construction of the walls in order to keep out the moisture.

Planing-mill shavings are better than sawdust for insulating purposes; they are elastic, do not settle readily, and do not absorb moisture so readily as sawdust; and, most important, are free from dirt, bark, or chips. When used as filling for walls or ceiling, they should be well packed into place to prevent settling.

Sawdust has in the past been used to a great extent in rural districts for insulating walls of small cold-storage buildings, due to the fact that it is available in most country districts and usually without cost. It is not a very satisfactory material for insulating purposes, however, as it is always more or less damp. Furthermore the dampness not only destroys its insulating value, but it favors the growth of mold and rot, first in the sawdust itself and then in the walls of the building. The rotting and the consequent heating cause the sawdust to settle and leave open spaces which further weakens the insulation. When sawdust is to be employed it should be thoroughly dried before use.

There are several makes of commercial insulators that are a great deal better than either shavings or sawdust and are cheaper in the end, but their initial cost is somewhat greater. They are nearly uniform in their insulating value, and moisture has but little effect upon them. They are practically fireproof, occupy but little space, and will retain their efficiency indefinitely. To get the best results, however, they should be installed by experienced men.

DRAINAGE.

Provision should be made for thorough drainage. In houses that have the floor below the level of the ground, sufficient drainage usually can be obtained through the soil, especially if the soil is porous. It may be necessary, however, with a clay soil, to excavate a foot or two and fill in with cinders or gravel, and to place a 3-inch porous tile under the floor. This drain should be properly trapped or sealed to prevent warm air from entering the building through the floor. In place of the tile a satisfactory drain may be constructed in houses having a ground floor by digging a ditch under the floor of the house and filling the same with broken stone or gravel, well packed into place. This drain should be led out with sufficient fall to carry away the water.

All floors should be sloped downward toward the center of the room to prevent the ice from falling against the walls of the building and in houses having water-tight floors to carry the water to the drain.

VENTILATION.

There is bound to be more or less melting of ice, no matter what the construction of the building may be, and this will cause moisture to settle on the walls and ceiling of the room. If the building is of wood construction the moisture is absorbed by the wood, and rot and decay follow. Therefore wooden houses should be provided with means of ventilation which can be controlled at will. The ceiling of such houses should be sloped up to the center in order to assist the circulation and carry the warm, moisture-laden air to the ventilator. In those houses in which some form of commercial insulation is used that will take a cement finish on the interior no ventilation is considered necessary. The building should be so constructed that there will be a circulation of air through the outer walls and at the eaves to the ventilator on the roof, as these air currents tend to break up the heat radiation through the walls and roof.

WATERPROOFING.

It is of the utmost importance that brick, concrete, and wooden buildings be waterproofed. Brick and concrete work may be rendered waterproof by painting the outside of the wall with white lead and oil or by coating the walls with a preparation of paraffin or asphalt, or by some of the patented compounds. The preparation containing paraffin or asphalt should be applied hot, and the walls should also be heated previously to application.

There are on the market several water-excluding paints and compounds for preserving wood. Creosote is considered one of the best preservatives, provided the wood is thoroughly impregnated with it, but on account of its odor it should not be used in houses where food products are stored.

GENERAL SPECIFICATIONS FOR VARIOUS TYPES OF ICE HOUSES.

POLE ICE HOUSE—UNINSULATED (PLAN E 5—FIG. 5).

Floors.—To consist of 12 inches of coarse gravel tamped into place as shown in drawing.

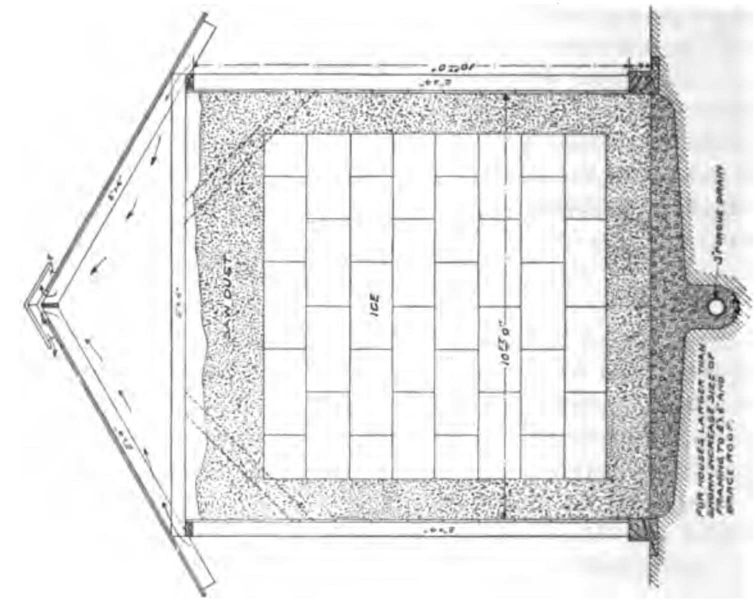


FIG. 6.—Framed ice house, uninsulated.

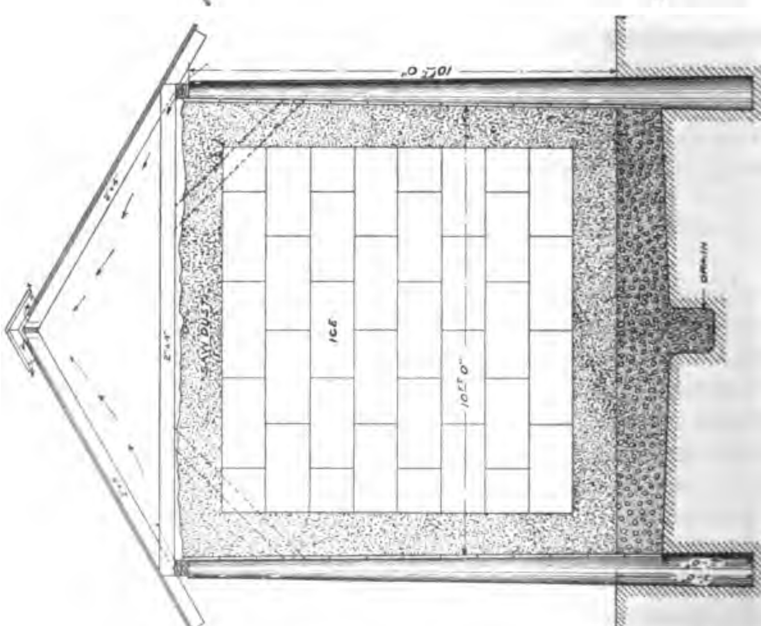


FIG. 5.—Pole ice house, uninsulated.

Walls.—Set up posts about 3 feet centers, as indicated on drawing, extending 3 feet in the ground, and capped by a plate made up of two pieces of 2 by 4. Sheathe the inside with 1-inch boards. The posts and boards below the ground line should be treated with some preserving compound.

Ceiling.—No ceiling is provided.

Roof.—The same type of roof may be employed as with the framed houses.

Doors. —A door may be provided by cutting out the boards between two posts in the end of the house and closing the same by placing short boards across the opening on the inside and packing sawdust against them to hold them in place.

Drainage.—Drainage to be provided for by sloping the floor toward the center of the house so that the water will tend to run to the center. A ditch is dug as indicated and filled with gravel and small stones. This ditch is led outside to a suitable point, where there is a sufficient fall to carry away the water. If advisable, a 3-inch porous drain tile may be provided as shown for the uninsulated frame house. This drain should be properly trapped, however, to prevent the entrance of warm air.

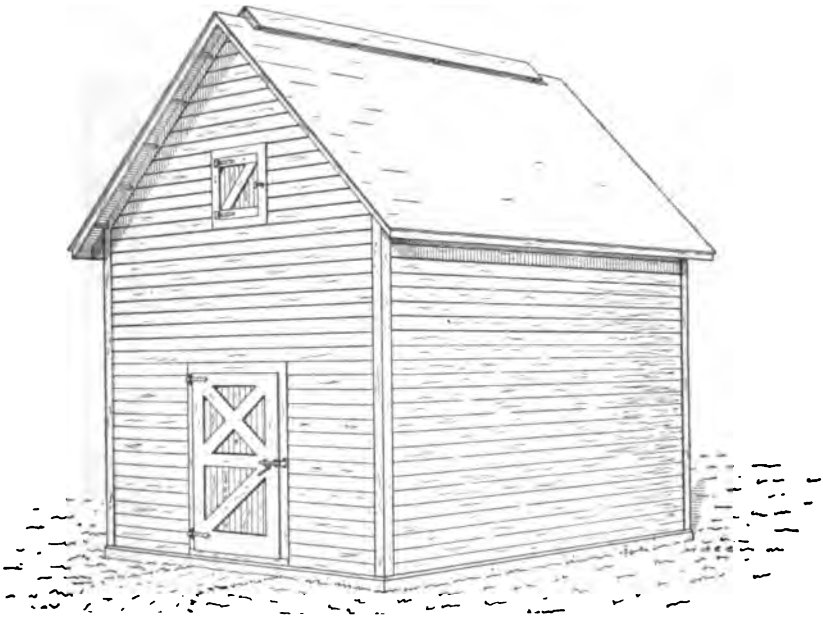


FIG. 7.—Wooden ice house, insulated with sawdust or mill shavings. (Perspective view.)

FRAMED ICE HOUSE—UNINSULATED (PLAN E 6—FIG. 6).

Floor.—To consist of 12 inches of coarse gravel tamped into place as shown on drawing.

Walls.—On a 2 by 10 inch mud sill place 6 by 6 inch sills. Set up 2 by 4 inch studs spaced about 2 feet centers, and on the inside of these nail 1-inch boards. The studding to be capped by a 2 by 4 inch plate as indicated. The mud sills and sills should be treated with creosote.

Ceiling.—No ceiling is provided.

Roof.—The same type of roof may be employed as in the insulated framed house.

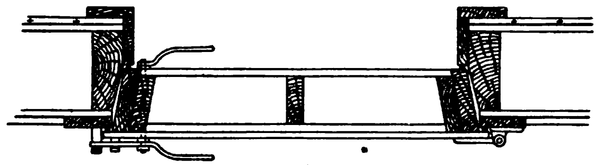
Doors.—A door may be provided as suggested for the pole ice house.

Drainage.—To be provided for by sloping the floor toward the center of the house so that the water will tend to run to the center. A ditch is dug as indicated and a 3-inch porous drain tile laid, being packed around with small stones and gravel. The tile should be led outside and efficiently trapped to prevent the entrance of warm air.

WOODEN ICE HOUSE INSULATED WITH SAWDUST OR MILL SHAVINGS (PLANS E 7 AND E 8—FIGS. 7 AND 8).

The drawings illustrate a house with and without milk room.

Framing.—All framing used should be dry, square-edged, sawed fair and full to the sizes given, and should not contain any of the following defects: Worm



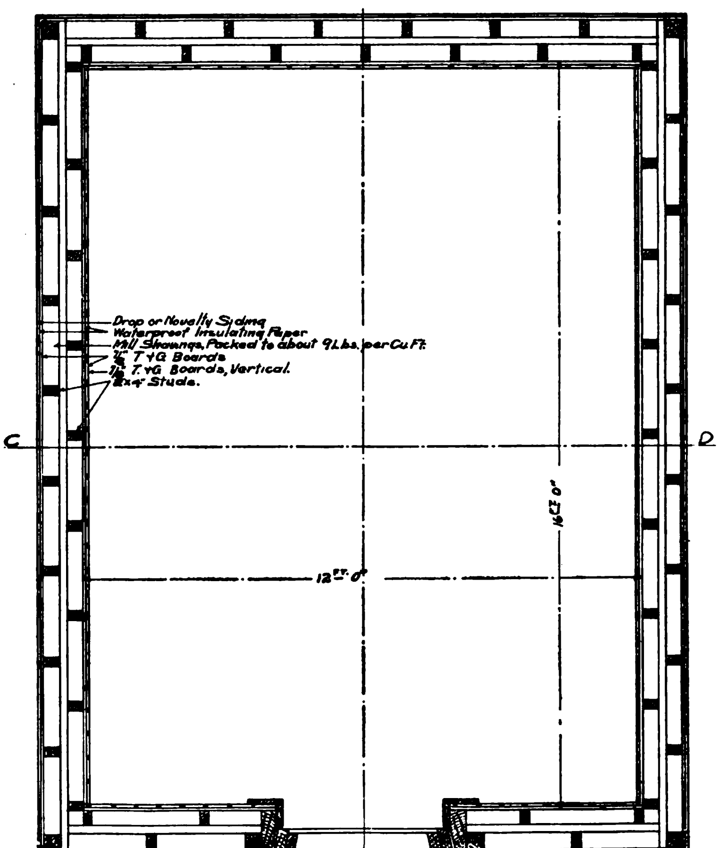


FIG. 7*a*.—Wooden ice house, insulated with sawdust or mill shavings. (Ground plan of fig. 7.)

holes, shakes, heart pith, warped, twisted, or unevenly sawed lumber, rotten, or unsound knots. Sizes to be as shown on drawings.

Boards.—All boards used should be thoroughly dry and sound and free from loose knots, heart centers, shakes, or splits, and should be dressed and tongued and grooved. Unseasoned boards should be carefully avoided.

Papers.—All paper used should be heavy waterproofed insulating paper, not the ordinary building paper. Double thickness of paper should be used in all cases, each layer lapping 6 inches over the preceding one. The layers should extend continuously around all corners, and breaks should be carefully covered.

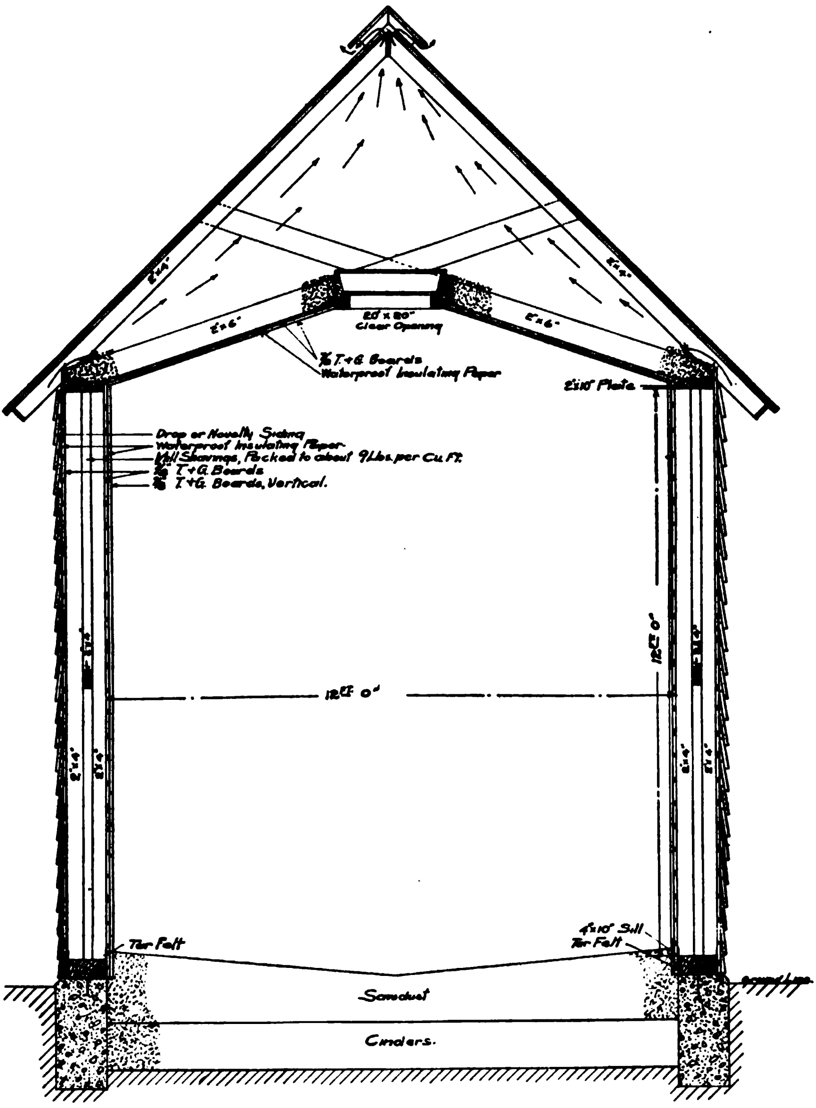


FIG. 7*b*.—Wooden ice house, insulated with sawdust or mill shavings. (Section on *C–D* of fig. 7*a*.)

Insulation.—When shavings or sawdust are used they should be thoroughly dry and free from dirt, chips, and bark, and well packed into place. When commercial insulation is used and installed by the manufacturers it is usually under guaranty that the insulation will not transmit more than a certain amount of heat under given conditions.

Cinders.—Coal cinders should be used where obtainable to cover the ground area of building, in preference to sand or gravel.

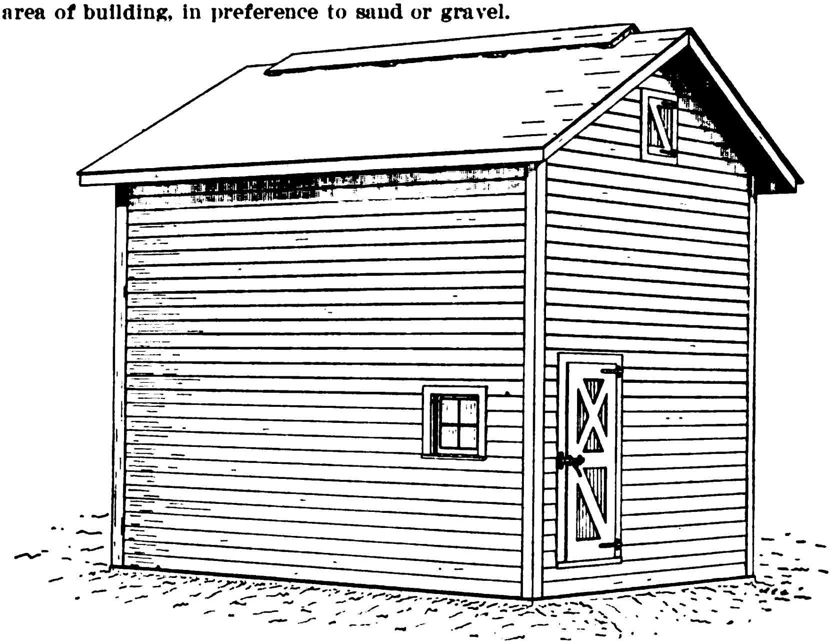


FIG. 8.—Wooden ice house, insulated with sawdust or mill shavings. (Perspective view.)

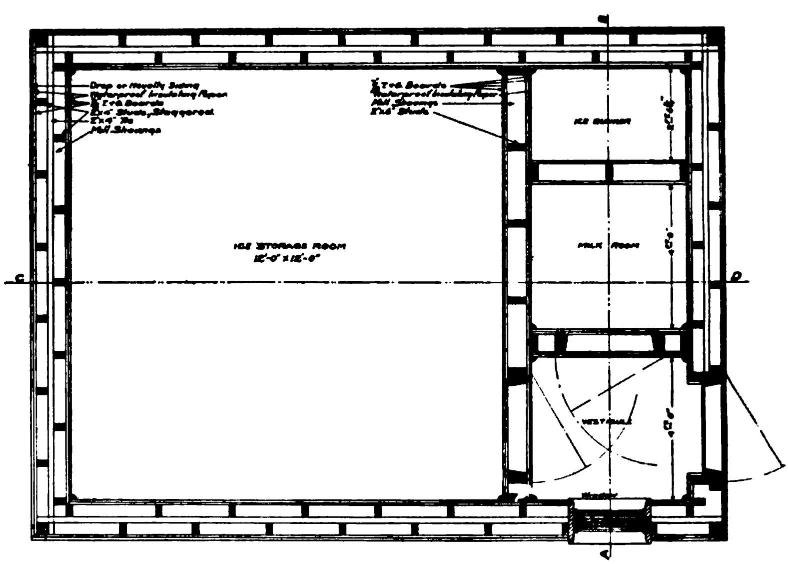


FIG. 8*a*.—Wooden ice house, insulated with sawdust or mill shavings. (Ground plan of fig. 8.)

Excavating and grading.—Excavate for floor and foundations sufficient to get a solid and firm footing. Grade entire floor to level shown and roll and tamp until firm and solid.

Foundations.—Footings should be of stone or concrete of size shown on drawings and of sufficient depth to insure a solid foundation.

Carpenter work.—All work to be executed in a substantial workmanlike manner.

Walls.—Set up double rows of 2 by 4 staggered with one 2 by 4 tie, as shown on drawings, and cover outside with one course of ⅞-inch tongued-and-grooved boards. Place on the outside of this two layers of waterproofed insulating paper and then a good quality of drop or shiplap siding. For inside of room place directly on studs one course of ⅞-inch tongued-and-grooved boards, then two layers of waterproofed insulating paper, and finish with one course

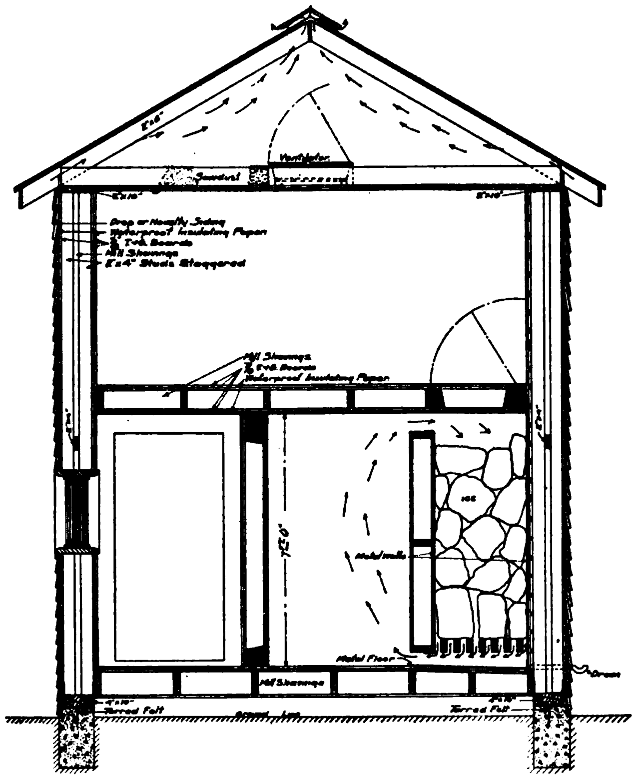


FIG. 8*b*.—Wooden ice house, insulated with sawdust or mill shavings. (Section on *A–B* of fig. 8*a*.)

of ⅞-inch tongued-and-grooved boards. Paper to extend continuously around the corners and lap 6 inches.

Ceiling.—Ceiling to be constructed as shown on drawings, with one course of ⅞-inch matched boards nailed to joists, then two layers of waterproofed insulating paper, following by a course of ⅞-inch tongued-and-grooved boards.

Roof.—Roof to be sheeted with 1-inch rough board and covered with good quality of shingles laid 4½ inches to weather and securely nailed. Or some one of the patented roofings may be used.

Doors.—Doors to be constructed as shown on detail drawings, of a good quality of seasoned lumber. Commercial doors can be bought at a reasonable price and will probably give better satisfaction than those constructed by an inexperienced carpenter.

Drainage.—Provide for thorough drainage by filling in a floor about 12 inches deep with cinders or gravel, and if necessary provide a 3-inch porous tile drain. Drain to be properly trapped to prevent warm air from entering room.

Ventilation.—Provide ventilation as shown on drawings.

FRAMED ICE HOUSE WITH COMMERCIAL INSULATION (PLAN E 9—FIG 9.)

Floors.—Excavate to a proper depth, depending on the character and lay of the soil, and lay a base of 4-inch concrete. Cover this with hot asphalt and lay directly on this 3 inches of good commercial insulation with all joints fitted. Cover this with another layer of hot asphalt followed by a 2-inch layer of concrete. Finally finish with $\frac{1}{2}$-inch Portland cement mortar. Floors to have an incline toward the drain of 1 inch in 4 feet.

Walls.—Set up 2 by 6 inch studs, as shown, and cover these on the outside with drop or novelty siding. On the inside cover studs with one course of $\frac{7}{8}$-inch

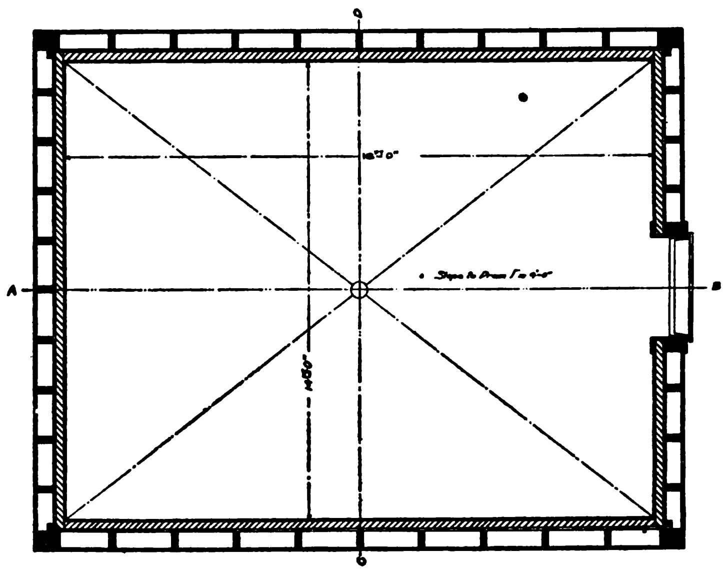


FIG. 9.—Framed ice house with commercial insulation. (Ground plan.)

tongued and grooved boards followed by a layer of water-proofed insulating paper. Afterwards securely nail directly on the wall 3 inches of good commercial insulation, followed by $\frac{1}{2}$-inch Portland cement finish. The space between studs to be provided, as shown, with an opening at the top and bottom for the circulation of air.

Ceiling.—To have one course of $\frac{7}{8}$-inch tongued-and-grooved boards nailed directly to the joists, then covered with one course of waterproofed insulating paper followed by 2 inches of good commercial insulation nailed directly to ceiling. Finish with $\frac{1}{2}$-inch Portland cement plaster. For additional protection a layer of dry sawdust, from 6 to 12 inches thick, may be placed on top of the ceiling.

Roof and doors.—The same type of roof and door may be used as on the other wooden houses.

Drainage.—The floor to slope toward the center 1 inch in 4 feet, and a 3-inch glazed-tile drain to lead from the center of the floor to a convenient point outside the building where sufficient fall may be had to carry off the water. The drain to be properly trapped to prevent warm air from entering room.

SMALL CONCRETE ICE HOUSE (PLAN E 10—FIG. 10.)

The building may be constructed of solid concrete or of concrete blocks. The foundation trenches should be dug 10 inches wide and 2½ feet deep and filled with concrete proportioned 1 part cement, 2½ parts sand, and 5 parts broken stone. Above the ground level the walls may be made either of concrete blocks laid up in a 1 to 2 cement-sand mortar or of solid concrete. For the solid walls above the ground level the concrete should be proportioned 1 bag of Portland cement to 3 cubic feet of sand and 5 cubic feet of crushed rock, or 1 part cement to 6 parts bank-run gravel.

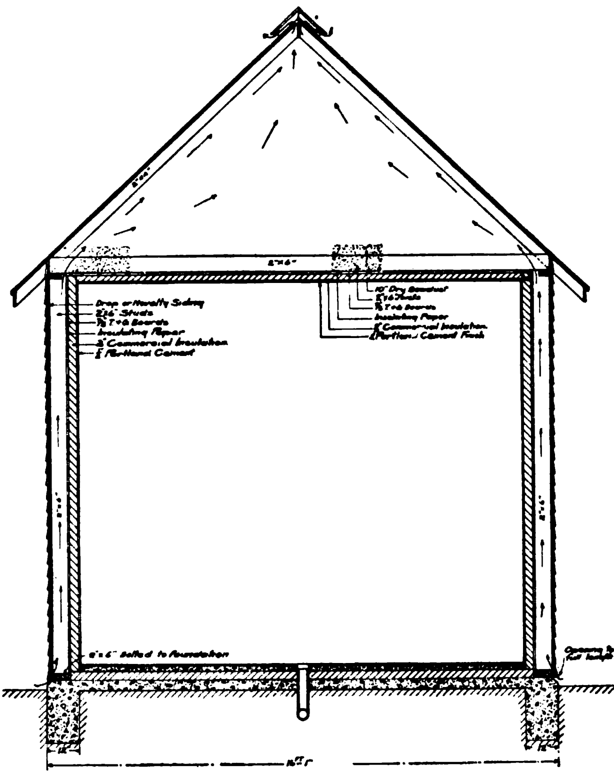


FIG. 9a.—Framed ice house with commercial insulation. (Section on *C–D* of fig. 9.))

In building up the concrete walls movable forms are used for holding the wet concrete in place until it hardens. These forms should be 3 feet high and extend entirely around the building. After filling the forms with concrete it should be allowed to stand for a day in order to harden, when the forms may be loosened, moved up, and again filled.

During the construction of the walls ⅜-inch reinforcing rods should be used, spaced 18 inches apart, running in both directions. Stagger the rods by placing half of them 3 inches from the outside edge and the other half 3 inches from the inside edge of wall. Embed two rods, or an old wagon tire cut in two and straightened, in the concrete 2 inches above the door opening.

For holding the plates on top of the walls sink a ½-inch bolt 10 inches long head down 6 inches into the concrete.

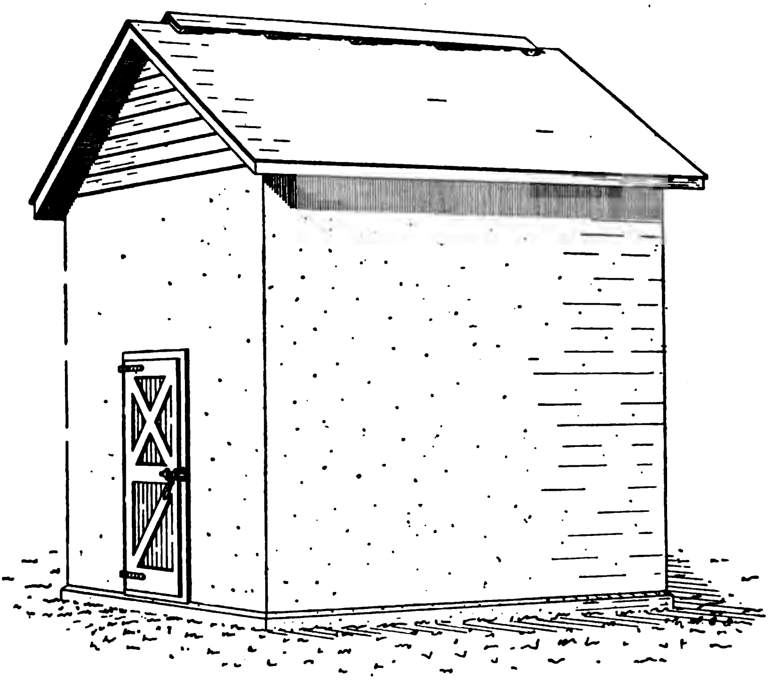


FIG. 10.—Small concrete ice house. (Perspective view.)

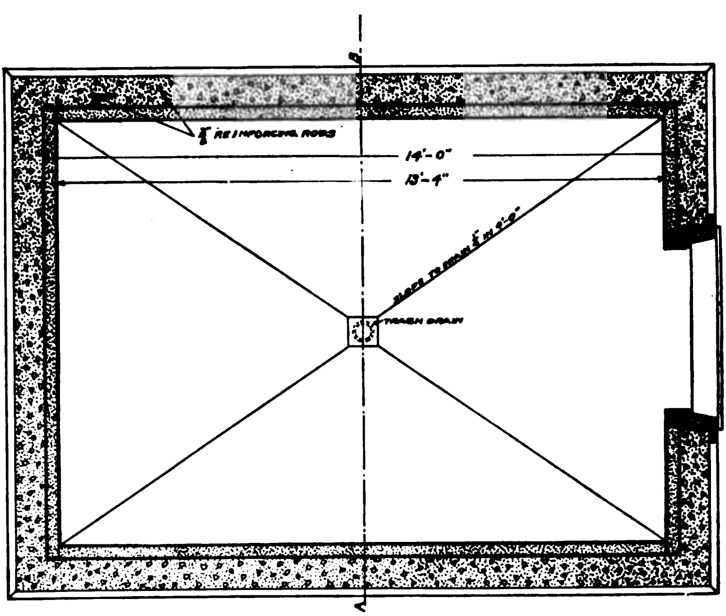


FIG. 10a.—Small concrete ice house. (Ground plan of fig. 10.)

Lay a 4-inch concrete floor on the natural ground and on top of this lay 3 inches of cork-board insulators embedded in hot asphalt followed by 2 inches of concrete sloped 1 inch in 4 feet to trash drain. The floor should be finished with ½-inch Portland cement plaster.

The cork-board insulation should be erected on the walls and ceiling in a ½-inch bed of Portland cement mortar, mixed in the proportion of 1 part of Portland cement to 2 parts of clean, sharp sand. All vertical joints should be broken and all joints made tight. A ½-inch Portland cement finish to be applied to the walls and ceiling as well as to the floor.

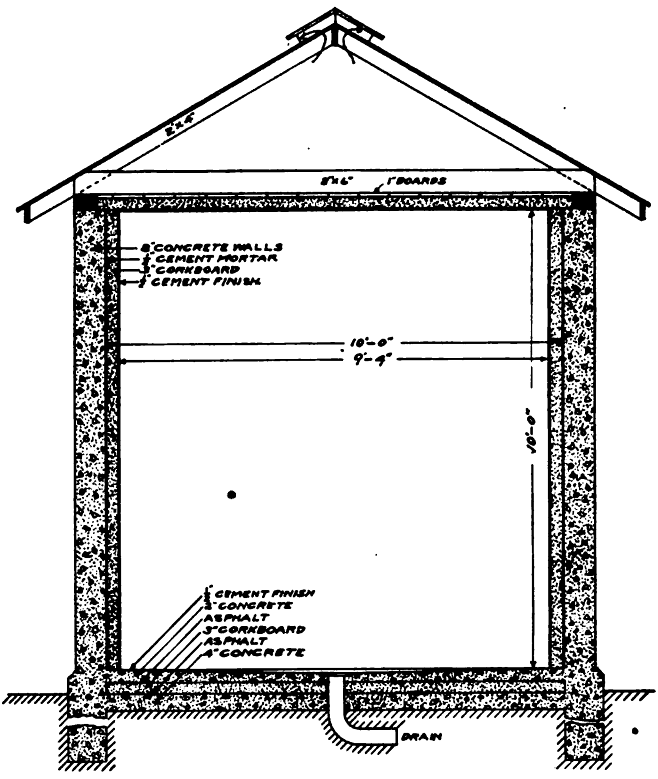


FIG. 10*b*.—Small concrete ice house. (Section on *A–B* of fig. 10*a*.)

In many cases it will be cheaper to crib the walls to their full height instead of using sectional forms, as a part of the form lumber can be used in the roof and ceiling and the remainder can generally be used to advantage on the farm.

GENERAL SUMMARY.

(1) Wherever ice is abundant the cost of harvesting and storing is usually very small.

(2) If a stream of water is available, a small ice pond can generally be constructed on the farm by building a dam.

(3) In building an ice house care shoul. . caken to provide for proper drainage and ventilation. The drain should be efficiently trapped to prevent air from entering the house through the drain.

(4) The efficient insulating of ice houses is of the utmost importance, consequently great care should be exercised in the selection and installation of the insulating material.

(5) About 40 cubic feet of space should ordinarily be allowed for a ton of ice. A cubic foot of ice weights about 57 pounds.

(6) Under general conditions about 1 pound of ice will be required to cool and keep 1 pound of cream in good condition until delivered to the creamery when deliveries are made three times a week.

(7) When storing ice about 50 per cent more should be packed than is actually needed. This amount allows for a heavy shrinkage and for household uses.

(8) The dairy farmer should provide annually one-half to 1 ton of ice per cow for cooling cream only and 1½ to 2 tons per cow if whole milk is cooled, depending upon the locality and other factors.

(9) If a cake of ice is kept floating in the water surrounding the cream cans when the ordinary cooling cans are used, the temperature will remain at about 40° F.

(10) Good ice-water tanks can usually be constructed for from $5 to $20.

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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

624

Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.
November 30, 1914.

NATURAL AND ARTIFICIAL BROODING OF CHICKENS.

By HARRY M. LAMON,
Senior Animal Husbandman in Poultry Investigations, Animal Husbandry Division.

The proper brooding of chickens is one of the most difficult operations on many poultry farms, especially for the beginner. Many poultry keepers who are able to secure good egg yields and fair hatches make a failure of brooding chickens, either in raising only a small percentage of the chickens hatched or in failing to rear strong, vigorous birds which develop into good breeding stock. Brooding is still in the experimental stage, and no one system has given perfect satisfaction.

Brooding with hens is the simplest and easiest way to raise a few chickens and is the method which is used almost exclusively on the average farm. Artificial brooders are necessary where winter or very early chickens are raised, where only Leghorns or other nonsetting breeds of poultry are kept, or where large numbers of chickens are raised commercially. Successful natural rearing of chickens requires convenient facilities, regular attention, and often tries one's patience, while artificial methods require a larger investment, close attention, and more care, but are more commonly used where large numbers of chickens are raised.

REARING CHICKENS WITH HENS.

Sitting hens should be confined to slightly darkened nests at hatching time and not disturbed unless they step on or pick their chickens when hatching, in which case the chickens should be removed as soon as dry, in a basket lined with flannel or some other warm material, and kept near a fire until all the eggs are hatched; or the eggs may be removed and placed under a quieter hen whose eggs are hatching at the same time. An incubator may also be used to keep the earliest hatched chickens warm, in case they are removed from the nest. If

NOTE.—Practical instructions in both natural and artificial brooding of chickens are contained in this bulletin.

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the eggs hatch unevenly, those which are slow in hatching may be placed under other hens, as hens often get restless after a part of the chickens are out, allowing the remaining eggs to become cooled at the very time when steady heat is necessary. Remove the egg shells and any eggs which have not hatched as soon as the hatching is over. Hens should be fed as soon as possible after the eggs are hatched, as feeding tends to keep them quiet; otherwise many hens will leave the nest. In most cases it is best that the hen remain on the nest and brood the chickens for at least 24 hours after the hatching is over.

Hens are often used to raise incubator-hatched chicks and to take the place of the artificial brooder, a practice that is in operation on many poultry farms. A few eggs are put under the hen four or five days before the incubator is to hatch. In the evening following the hatch of the incubator, after the chickens are thoroughly dry, one or two are put under the hen, and if she is found to mother them properly, the next evening as many more are added as she can brood or care for properly. Hens will successfully brood 10 to 15 chickens early in the breeding season, and 18 to 25 in warm weather, depending upon the size of the hen. This method of handling chickens does away with the artificial brooder, and where one has only a small number of chickens to raise it is a very easy manner in which to handle them, and also a good method when it is desired to raise separately special lots of chicks. It should be borne in mind, in adding chickens to a hen which already has some to brood, that it is best to add those of the same color and age as the ones already with her, as the hen will often pick the later arrivals if they are of a color different from the ones she is already brooding. As a rule this transferring should take place at night, although with a quite docile hen it can be done in the morning.

FIG. 1.—Dusting hen with insect powder before setting, to kill lice.

Powder the hen with a good insect powder before moving her and the chickens to the brood coop. The hen should be dusted every two weeks or as often as necessary until the chickens are weaned. If lice become thick on the chickens, or if they are troubled with "head lice," a very little grease, such as lard or vaseline, may be applied with the fingers on the head, neck, under the wings, and around the vent. Great care should be taken, however, not to get too much

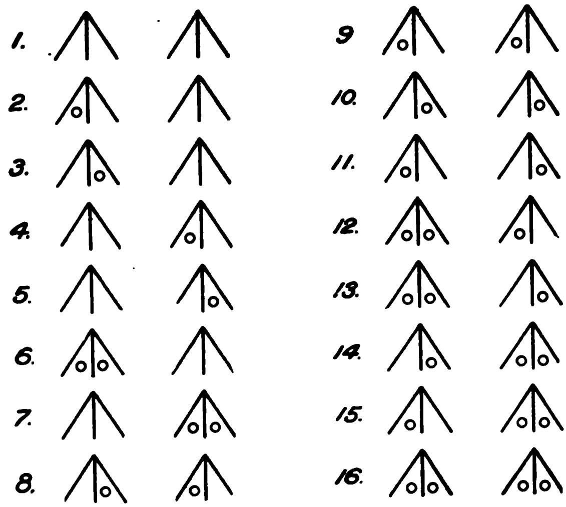

FIG. 2.—Sixteen different methods of marking chicks. If this method is followed the age of the flock can be easily told.

grease on the chickens, as it will stop their growth and in some cases may prove fatal.

The brood coop should be cleaned at least once a week and kept free from mites. If mites are found in the coop, it should be thoroughly cleaned and sprayed with kerosene oil or crude petroleum. From 1 to 2 inches of sand or dry dirt or a thin layer of straw or fine hay should be spread on the floor of the coop. Brood coops should be moved weekly to fresh ground, preferably where there is new grass. Shade is very essential in rearing chickens, especially during warm weather; therefore, the coops should be placed in the shade whenever possible. A cornfield makes fine range for young chickens, as they secure many bugs and worms and have fresh ground to run on most of the time, due to the cultivation of the ground, and have abundant shade at the same time.

FIG. 3.—Hen and chicks allowed free range. Large losses are sustained where this method of growing chicks is pursued.

Toe punch or mark all the chickens before they are transferred to the brooder or brood coop, so that their age and breeding can be readily determined after they are matured. Farmers frequently keep old hens on their farms and kill the younger hens and pullets, because they are unable to distinguish between them after the pullets have matured. The accompanying diagram (fig. 2) shows 16 different methods of marking chickens.

BROOD COOPS.

Chickens hatched during the winter should be brooded in a poultry house or shed while the outside weather conditions are unfavorable; after the weather becomes settled, they should be reared in brood coops out of doors. Brood coops should be made so that they can be closed at night, to keep out cats, rats, and other animals, and enough

FIG. 4.—Hens confined to the brood coops. There is a wire door back of the boarded front of this coop which can be slid forward. This arrangement furnishes the hen and chicks plenty of ventilation and fresh air at night and prevents any animals from entering the coop.

ventilation should be allowed so that the hen and chicks will have plenty of fresh air. A good coop is illustrated in figure 4. This coop is used at the Government poultry farm at Beltsville, Md. Full details and specifications for building it are given in Farmers' Bulletin 574, "Poultry-House Construction," page 13.

The hen should be confined in the coop until the chicks are weaned, while the chickens are allowed free range after they are a few days old. Where hens are allowed free range and have to forage for feed for themselves and chicks, they often take them through wet grass, where the chicks may become chilled and die. Most of the feed the chicks secure in this manner goes to keep up the heat of the body, whereas feed eaten by those that are with a hen that is confined produces more rapid growth, as the chicks do not have so much exercise. Then, too, in most broods there are one or two chicks that are weaker than the others, and if the hen is allowed free range the weaker ones often get behind and out of hearing of the mother's cluck and call. In most cases this results in the loss and death of these chicks, due to becoming chilled. If the hen is confined the weaklings can always find shelter and heat under her, and after a few days may develop into strong, healthy chicks.

The loss in young chicks due to allowing the hen free range is undoubtedly large. Chickens frequently have to be caught and put into their coops during sudden storms, as they are apt to huddle in some hole or corner where they get chilled or drowned. They must

FIG. 5.—Brood coop with window sash used for door. When this door is closed it does not allow enough ventilation for the hen and chicks.

be kept growing constantly if the best results are to be obtained, as they never entirely recover from checks in their growth even for a short period. Hens are usually left with their young chicks as long as they will brood them, while some hens frequently commence to lay before the chickens are weaned.

Several styles of coops are shown in figures 5 to 8, inclusive, the undesirable features of which are pointed out.

ARTIFICIAL BROODING.

The artificial method of brooding chickens consists in supplying artificially as nearly as possible the heat furnished by the hen under natural conditions. The temperature of a hen is about 106° F.,[1] but as hens seldom sit closely on chickens the latter do not receive

[1] See Farmers' Bulletin 585, "Natural and artificial incubation of hens' eggs."

this degree of heat. Hens adapt their methods of brooding to conditions such as temperature, size of the chickens, wet weather, etc., and the operator of a brooder must meet these conditions as well as

FIG. 6.—Brood coop having glass about half way across the front. This could be improved by having a wire door pass back of the slatted portion of the front.

he can. This lack of adjustability to changes is one of the weakest points in our present brooders and brooder systems. Some of the most important faults in the management of brooders are over-

FIG. 7.—V-shaped brood coop. This coop is not provided with any arrangement for closing at night as a protection against enemies of the hen and chickens.

crowding and lack of ventilation, while the chickens fail to get sufficient exercise. The brooder should supply the proper temperature, be readily adapted to changes in weather conditions, and be easy to clean and well ventilated.

Chickens are usually left in the incubator from 24 to 36 hours after hatching, without feeding,[1] before they are removed to the brooder, which should have been in operation for a day or two at the proper temperature for receiving the chickens. A beginner should try his brooding system carefully before he uses it. After placing the chickens in the brooder they can be given feed and water. Subsequent loss in chickens is frequently due to chilling received while taking them from the incubator to the brooder. They should be moved in a covered basket or receptacle in cool or cold weather.

HOVERS, BROODERS, AND BROODING SYSTEMS.

There are a large number of hovers, brooders, and brooding sys-

FIG. 8.—Brood coop with small run for hen, showing wire door which can be closed at night. The burlap covering on top of the coop and frame is to protect the hen from the sun and rain.

tems used throughout the country, some with success, although many are discarded as failures, while each year brings some modification or change. One poultryman uses a system successfully, while his neighbor may make a failure of the same system but does well with another. More difference of opinion exists as to the value of brooding systems than in any other part of poultry rearing, which shows that no system is ideal for all conditions or all people, but that success depends largely on individual handling and care. Many failures in brooding are due to weak chickens, which may be traced to faulty incubation or weakness in the breeding stock. Successful rearing of chickens depends primarily upon having healthy, vigorous breeding stock.

[1] See Farmers' Bulletin 585. "Natural and artificial incubation of hens' eggs."

Brooding systems may be classified as follows, according to their capacity: Individual brooders or hovers holding from 25 to 100 chickens; coal, gasoline, and engine or distillate oil stove brooders, with a capacity varying from 200 to 1,200 chicks; and hot-water pipe systems, the capacity of which is unlimited. The beginner, if possible, should thoroughly investigate the brooding equipment used on successful poultry farms which have been in operation for some years.

INDIVIDUAL HOVERS AND BROODERS.

The small individual hovers and brooders are heated with either hot air or hot water, with kerosene oil as the source of heat. Hovers

FIG. 9.—Artificial brooding of chicks, showing arrangement of outdoor brooders.

are used entirely inside, either in brooder houses or in small colony houses, while brooders are made for both indoor and outdoor use. Outdoor brooders are used with success and work very satisfactorily under most weather conditions. (See fig. 9.) The capacity of brooders and hovers is often overestimated, and one-half to two-thirds of the number of chickens commonly advised will do much better than a larger number. The danger from fire, due frequently to carelessness and lack of attention, is considerable in cheap brooders and hovers, while there is some risk in the best grades, although proper care will reduce this to a minimum. Individual hovers in colony houses or several in one large house are giving quite general satisfaction on small poultry farms, while the pipe system of brooding is commonly used in large commercial poultry plants and where extensive winter brooding is done. When a lamp is used as the source of heat, care should be taken to keep the wick and burner properly cleaned. Brooder lamps and stoves should be inspected several times a day. Do not fill the brooder lamp quite full of oil, as the heat from the lighted wick will expand the oil in the bowl and may cause it to overflow and catch fire.

Gasoline brooders, brooder stoves burning engine-distillate oil, and a separate individual hover heated by a coal fire are coming into more general use, each with a capacity varying from 200 to 1,500 chickens. These large individual brooders are used in colony houses, and when the chickens are weaned the colony house is used as a growing coop, which requires a smaller investment than the long, piped brooder house, and allows one to rear the chicks on range to good advantage. Brooder stoves with a capacity of from 500 to 1,500 chickens, heated by distillate oil, are used quite extensively in some sections of the country. These stoves are usually seen in houses which are about 18 feet square, but are occasionally found in long brooder houses. Most of them are equipped with a wafer regulator that controls the flow of oil which is fed automatically from a tank or barrel outside the house, or several stoves may be connected with the same supply tank. This system provides good ventilation, sufficient heat to keep the chickens from crowding, and requires a minimum of care.

Until one has had considerable experience it is best not to brood over 1,000 chickens in one flock, and a much smaller number would probably do better.

Individual hovers with a capacity of from 200 to 1,000 chickens have recently been placed on the market and appear to be giving satisfaction. Each hover is heated by a separate self-feeding coal stove which is adapted for use in a colony brooder house. The value of this brooder would appear to depend greatly on the efficiency of the heater and the time required to care for the stove.

HOT-WATER PIPE BROODERS.

This system consists of long brooder houses heated with hot water, coal being used for fuel almost exclusively. Many of the latest mammoth brooders are giving good success, and in these cases the labor of brooding a large number of chickens is less than where small individual brooders or hovers are used. These brooders are suitable for large poultry farms or for farms where most of the chickens are raised during the winter and early spring.

METHOD OF HEATING.

Brooders are heated either by overhead or bottom heat or by a combination of these two methods. Too much bottom heat does not give good results, while either the overhead or the combination methods are used successfully. Many pipe systems have a hover or cover over a section of the pipes in each pen, while others are used without them, and each appears to give good results with different operators. A piece of wool felt or cotton flannel is often used for this purpose. Gas and electricity are also used for heating brooders and hovers with good success, and where available they supply one of the steadiest and most convenient sources of heat. A brooder built along the style of the oil brooder stoves with gas or electricity as the source of heat should prove very satisfactory. Heaters for the mammoth brooders or hot-water pipe systems are usually equipped with automatic regulators, which are operated either by expansion of water or electric contact. Both types of regulators have given good satisfaction. A reliable regulator is very essential to success with any of these systems.

FIRELESS BROODERS.

Cold or fireless brooders are used in a small way by many people with success, and can be either purchased or built. As their construction is very simple, many people prefer to build rather than to buy them. The body heat of the chickens is the source of warmth in this system, which requires that several chickens be placed in a small receptacle to generate and retain the heat. Small fireless hovers with adjustable quilts or covers are used in both indoor and outdoor brooders and in colony houses. A box 18 inches square and 8 inches deep makes a good hover of this type. The number and position of the quilts used over the chickens in this box are regulated according to the weather and the number of the chickens in the brooder. In very cold weather the quilts should sag so as to rest on the backs of the newly hatched chickens and there should be little or no empty space in the hover, while in warmer weather or with older chickens the quilts or covers are raised or part of them removed. From 12 to 40 chicks are usually placed in a fireless brooder, 25 being the average number, while small lots do better than larger ones under this method. The litter in these brooders must be changed frequently, and the chickens must be watched carefully and closely to see that they are comfortable and do not sweat. Fireless brooders may be used in connection with heated brooders, using the latter for 7 to 10 days and reducing the heat, which should be governed by the season of the year and outdoor temperatures, before transferring the chickens to the fireless brooder. When first placed in the fireless brooders the chickens may have to be put under the hovers frequently, until they learn where to get warm. Good results are also obtained with these brooders when used in a heated room.

CORRECT TEMPERATURES FOR BROODING.

The best temperature at which to keep a brooder or hover depends upon the position of the thermometer, the style of the hover, the age of the chickens, and the weather conditions. Aim to keep the chickens comfortable. As the operator learns by the actions of the chickens the amount of heat they require, he can discard the thermometer if he desires. When too cold they will crowd together and try to get nearer the heat. If it is found in the morning that the droppings are well scattered under the hover it is an indication that the chickens have had enough heat. If the chickens are comfortable at night they will be spread out under the hover with the heads of some protruding from under the hover cloth. Too much heat will cause them to pant and gasp and sit around with their mouths open.

It is impossible to state for each case at what temperature the brooders should be kept to raise young chickens; however, it will run from 90° up to 100° in some cases, as some broods of chickens seem to require more heat than others, an average being 93° to 95° for the first week or 10 days, when the temperature is gradually reduced to 85° for the following 10 days, and then lowered to 70° or 75° for as long as the chickens need heat. This depends somewhat on the season of the year and the number of the chickens, as it can be readily seen that the heat generated by 50 chickens would raise the temperature under the hover to a higher degree than the heat given off by a lesser number, consequently the amount of heat furnished by the lamp or stove will have to be regulated accordingly. As the chickens grow larger and need less heat, the lamps may be used only at night, and later only on cold nights. The heat is usually cut off at the end of 4 or 5 weeks in March or April in the vicinity of Washington, D. C., while winter chickens have heat for 8 or 10 weeks, or until they are well feathered. Care should be taken to prevent chilling or overheating the chickens, which weakens them and may result in bowel trouble.

Chickens need a cool place for scratching and exercising in addition to heat. Indoor brooders and hovers can be used successfully in unheated brooder houses except during the coldest weather in most sections of the country. Outdoor brooders usually have a cool compartment for exercising, where the chickens are fed in cold, stormy weather. If winter chickens are being raised, it is advisable to heat the brooder house to a temperature of 60° to 70°, regardless of the temperature of the hover, which often requires placing brooder pipes around the outside walls of the brooder house. The need of this heat depends entirely upon the brooding system and the weather conditions; but it is absolutely necessary that the heat be kept at the desired temperature under the hover. Brooders and hovers should have from one-half to 2 inches of sand, dry dirt, cut clover, or chaff spread over the floor and in the brooder-house pen. The hovers should be cleaned frequently, as cleanliness is very essential in raising chickens successfully.

When chickens are first put into the brooder they should be confined under or around the hover by placing a board or wire frame a few inches outside (this would not apply to the small outdoor colony brooders). The fence or guard should be moved gradually farther away from the hover and discarded entirely when the chickens are 3 or 4 days old or when they have learned to return to the source of heat. Young chickens should be closely watched to see that they do not huddle together or get chilled. They should be allowed to run on the ground whenever the weather is favorable, as they do much better than when kept continuously on cement or board floors. Weak chickens should usually be killed as soon as noticed, as they rarely make good stock, while they may become carriers of disease. Brooders should be disinfected at least once a year, and more frequently if the chickens brooded in them have had any disease.

FEEDING YOUNG CHICKENS.

Young chickens should be fed from three to five times daily, depending upon one's experience in feeding. Undoubtedly chickens can be grown faster by feeding five times daily than by feeding three times daily, but it should be borne in mind that more harm can be done to the young chickens by overfeeding than by underfeeding, and at no time should they be fed more than barely to satisfy their appetites and to keep them exercising, except at the evening or last meal, when they should be given all they will eat. Greater care must be exercised not to overfeed young chicks that are confined than those that have free range, as leg weakness is apt to result in those confined.

The young chicks may be fed any time after they are 36 to 48 hours old, whether they are with a hen or in a brooder. The first feed may contain either hard-boiled eggs, johnnycake, stale bread, pinhead oatmeal, or rolled oats, which feeds or combinations may be used with good results. Mashes mixed with milk are of considerable value in giving the chickens a good start in life, but the mixtures should be fed in a crumbly mass and not in a sloppy condition. After the chickens are two months old they may be fed four times daily, and after three months old three times daily, with good results. Johnnycake composed of the following ingredients in the proportions named is a very good feed for young chicks: One dozen infertile eggs or 1 pound of sifted beef scrap to 10 pounds of corn meal; add enough milk to make a pasty mash, and 1 tablespoonful of baking soda. Dry bread crumbs may be mixed with hard-boiled eggs, making about one-fourth of the mixture eggs, or rolled oats may be used in place of the bread crumbs. Feed the bread crumbs, rolled oats, or johnnycake mixtures five times daily for the first week, then gradually substitute for one or two feeds of the mixture finely cracked grains of equal parts by weight of cracked wheat, finely cracked corn, and pinhead oatmeal or hulled oats, to which about 5 per cent of

FIG. 10.—Frame covered with wire netting to protect feed of young chicks from the older fowls.

cracked peas or broken rice and 2 per cent of charcoal, millet or rape seed may be added. A commercial chick feed may be substituted if desired. The above ration can be fed until the chicks are two weeks old, when they should be placed on grain and a dry or wet mash mixture.

After the chicks are 10 days old a good growing mash, composed of 2 parts by weight of bran, 2 parts middlings, 1 part cornmeal, 1 part low-grade wheat flour or red-dog flour, and 10 per cent sifted beef scrap, may be placed in a hopper and left before them at all times. The mash may be fed either wet or dry; if wet, only enough moisture (either milk or water) should be added to make the feed crumbly, but in no sense sloppy. When this growing mash or mixture is not used a hopper containing bran should be accessible to the chickens at all times.

When one has only a few chickens it is less trouble to purchase the prepared chick feeds, but where a considerable number are reared it is sometimes cheaper to buy the finely cracked grains and mix them together. Many chick feeds contain a large quantity of grit and may contain grains of poor quality, so that they should be carefully examined and the quality guaranteed before they are purchased.

As soon as the chickens will eat the whole wheat, cracked corn, and other grains, the small-sized chick feed can be eliminated. In addition to the above feeds the chickens' growth can be hastened if they are given sour milk, skim milk, or buttermilk to drink. Growing chickens kept on a good range may be given all their feed in a hopper, mixing 2 parts by weight of cracked corn with 1 part of wheat, or equal parts of cracked corn, wheat, and oats in one hopper and the dry mash for chickens in another. The beef scrap may be left out of the dry mash and fed in a separate hopper, so that the chickens can eat all of this feed they desire. If the beef scrap is to be fed separately it is advisable to wait until the chicks are 10 days old, although many poultrymen put the beef scrap before the young chickens at the start without bad results. Chickens confined to small yards should always be supplied with green feed, such as lettuce, sprouted oats, alfalfa, or clover, but the best place to raise chickens successfully is on a good range where no extra green feed is required. Fine charcoal, grit, and oyster shell should be kept before the chickens at all times, and cracked or ground bone may be fed where the chickens are kept in small bare yards, but the latter feed is not necessary for chickens that have a good range.

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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

625

Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.
December 12, 1914.

COTTON WILT AND ROOT-KNOT.

By W. W. Gilbert,
Pathologist, Office of Cotton and Truck Disease and Sugar-Plant Investigations.

INTRODUCTION.

Throughout the sandy sections of the cotton belt, where cotton wilt and root-knot occur every year to an increasing extent, there is urgent need for a fuller understanding of these diseases and the important relation they bear to each other and to the farmer's margin of profit. Wilt occurring alone causes serious loss to the cotton crop, not only by killing large numbers of plants, but, further, by stunting very many others and thus greatly reducing the yield. Cotton root-knot by itself causes a dwarfing of the plants and a consequent decrease in yield over large areas. Often the farmer does not notice this or attributes it to an unfavorable season, poor soil, lack of proper fertilization, or some local condition. Where these two diseases occur together, which is frequently the case, the loss is often so great that it becomes well-nigh impossible by the usual methods of cultivation to grow the principal money crop of this section without an actual loss. In other words, wilt and root-knot then become the most important limiting factors in the production of cotton. To remedy this condition the whole scheme of farming must often be changed and planned with special reference to the control of these highly important enemies of the cotton crop. Rotation of crops for the control of root-knot and the use of varieties of cotton resistant to wilt are more essential to the profitable growing of the crop in badly diseased areas than fertilization or cultivation, although these are of prime importance.

Cotton wilt and root-knot occur to a greater or less extent in every cotton-producing State from North Carolina to Texas. The areas where wilt is of most general and serious occurrence are southern and eastern South Carolina, southwestern Georgia, and southeastern Alabama. The lines and dots on the accompanying map (fig. 1) show graphically the relative severity of wilt in the States where it occurs. Parallel lines indicate sections where the disease is known to be general, while dots are used to mark territory less generally infected, each dot indicating a place where the disease is known to occur. The heavy line marks the approximate boundary between the sandy and alluvial soils of the Coastal Plain, where wilt and root-knot are most prevalent, and the clay soils of the Piedmont Plateau,

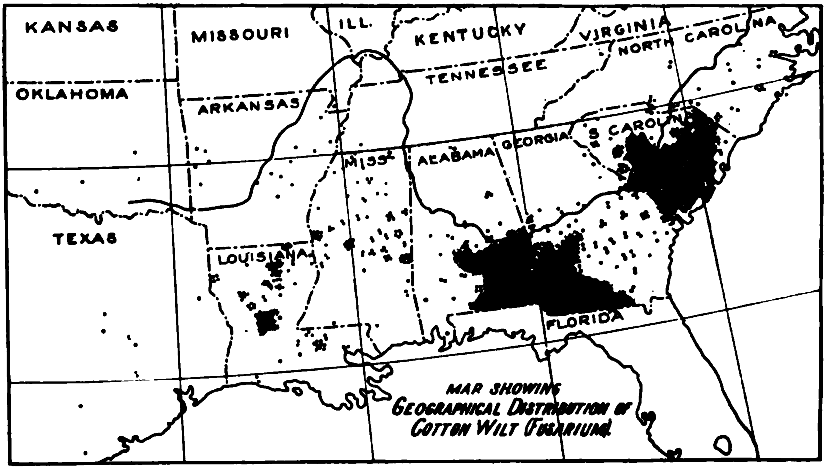

FIG. 1.—Map of the Southeastern States, showing the geographical distribution of cotton wilt. The shaded portions show where the wilt is general, while the dots indicate scattered localities where the disease is known to occur.

where the occurrence of these diseases is rare. Wilt without doubt exists in many places of which we have no authentic record, and it is

FIG. 2.—A wilt-diseased cotton plant, showing the wilted main stem on the left, from which the leaves have mostly fallen, and a new shoot on the right, not yet attacked.

rapidly spreading to new territory. It is probable that the disease will eventually be found in nearly all the cotton sections having sandy soils. Root-knot occurs even more generally than wilt in the same areas and soil types. Wherever sandy soils occur in the cotton belt root-knot is to be looked for.

While it is difficult to form a very accurate estimate of the damage caused by these diseases, the most authentic records available indicate that an annual loss of $10,000,000 is very conservative. The loss is occasioned not only by the death or dwarfing of affected plants, but by the lowering of the market value of infested land, by the increased cost of cultivation of such land, due to the growth of weeds where the cotton has died, and by the fact that badly diseased fields must often be used for crops less profitable than cotton. This situation is the more unfortunate because it is for the most part unnecessary. These diseases can be almost entirely controlled by the methods described in this bulletin.

FIG. 3.—Oblique section of a wilt-diseased cotton stem, showing the browning caused by the wilt fungus.

HOW TO RECOGNIZE COTTON WILT.

When the leaves of cotton plants wilt and fall without any apparent reason, blackroot, or wilt, is to be suspected. If a freshly wilted plant is examined (fig. 2) and the interior of the stem or root is found to be browned or blackened (fig. 3), the disease is almost sure to be wilt. Certain kinds of dwarfing of the main stem are likewise characteristic of wilt, particularly a reduction in the length and a shortening of the distance between the branches. This is often accompanied by the normal development of one or more of the basal limbs, due to partial infection (fig. 4). The disease may kill the plants in early May, or its first indication may be the sudden wilting and death of practically mature plants in mid-September. All through the season affected stalks die from the trouble.

FIG. 4.—A wilt-diseased cotton plant, showing the typical stunting of the main stem and the normal development of one lateral branch.

The first appearance of wilt in a field is usually in small rounded or irregular areas, which enlarge each season. Outside the spots where the plants are killed, dwarfed and sickly plants occur, which may survive and produce a small crop. Occasionally plants are found that remain alive in the worst infected areas. By selection from such resistant plants, varieties largely immune to the disease have been developed.

HOW TO RECOGNIZE COTTON ROOT-KNOT.

The detection of cotton plants affected by root-knot, except by an examination of the roots, is much more difficult than in the case of

FIG. 5.—Root-knot on a cotton plant grown on land where nonresistant cowpeas were raised the previous year.

wilt. Diseased plants are distinctly stunted but not appreciably deformed, as in wilt, and have a peculiar sickly yellowish green color on both leaves and stem. In times of drought affected plants are the first to show the lack of water and may wilt slightly in the middle of the day. If such a plant is pulled carefully or, better, dug up with a shovel, the roots will be found to be covered with swellings, or galls, from the size of a pinhead to a half inch or more in diameter, as shown in figure 5. If one of these knots is broken open, numerous pearly white rounded bodies about half the size of a small pinhead, the female nematodes (see fig. 11), can often be seen with the naked eye.

When root-knot occurs with wilt, which is often the case, the symptoms of both diseases are present. The plants usually all die or are so badly dwarfed that little or no cotton is produced.

IMPORTANT FACTS ABOUT COTTON WILT.

WILT CAUSED BY A FUNGUS.

Wilt is caused by a fungus, a minute moldlike plant growth (fig. 6) which enters the roots from the soil. It grows vigorously in the water-carrying vessels of the roots and stems (fig. 7), causing them to turn black. (See fig. 3.) It shuts off wholly or in part the water supply of the plant and eventually brings about the death of those badly affected. This fungus produces in great numbers several types of fruiting bodies, by which it is propagated. (See fig. 6.)

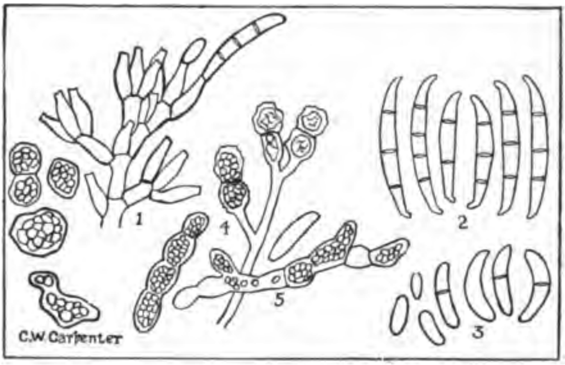

FIG. 6.—The cotton wilt fungus (*Fusarium vasinfectum* Atk.): 1, Conidiophore; 2, macroconidia; 3, microconidia; 4, chlamydospores; 5, bits of swollen hyphæ.

Closely related fungi of the same genus cause serious wilts of okra, coffee weed, cowpea, tomato, watermelon, potato, and other plants. Thus far, these diseases have not been proved to be communicable to cotton.

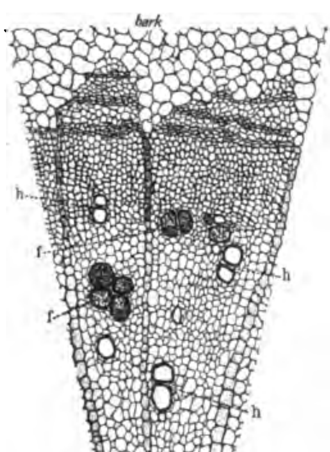

FIG. 7.—Enlarged section of part of a diseased cotton stem, showing vessels filled by the wilt fungus. Normal water vessels (*h*) are shown in comparison with several such vessels (*f*) plugged by the wilt fungus.

WILT SPREAD BY NUMEROUS AGENCIES.

Wilt is spread by the direct growth of the causal fungus through the soil and by any agency which will transfer spores or disease-infected soil from one field to another, such as cultivators, plows, and other tools, the feet of men or animals, wind, and drainage water. During heavy rains the overflow from diseased fields will carry the wilt to lower areas. To prevent this, terraces may often be built advantageously to turn the water into ditches. Stable manure and the compost heap may be infected by soil from the feet of mules used in a diseased field, and thus the wilt may be carried to new areas. The disease is often spread most noticeably along frequently traveled farm roads or paths. It is possible, but not yet proved, that the disease is carried in the seed.

WILT MOST SEVERE ON SANDY LAND.

Wilt occurs almost exclusively on soils of a sandy or sandy-loam nature. In most cases, the lighter the soil the more severe is the wilt. For this reason it is often worst in portions of the field where large quantities of sand have been washed by drainage water. Sandy ridges through the field or high sandy spots are also severely affected. Rarely has the disease been known to occur on clay soils, and then only when they were adjacent to infected sandy soils.

WET SEASONS FAVOR WILT.

It is a fact recognized by most farmers in wilt territory that the disease is more severe in wet seasons and less injurious in dry years. Abundant soil moisture favors a rapid growth of the cotton plant and likewise furnishes the best conditions for the development of the fungus. For this reason also, new cases of wilt are usually most numerous just after a rain.

ROOT-KNOT MAKES WILT WORSE.

When root-knot occurs with wilt, the amount of loss is very materially increased and different methods of control are made necessary. Cotton is moderately subject to root-knot, which reduces the yield in hundreds of fields whose owners are ignorant of its presence. The plant illustrated in figure 5 shows a typical severe case of root-knot on cotton. The wounds which the nematodes make in the roots furnish points of entrance for the wilt fungus, which then completes the destructive work. Whole fields are thus practically annihilated, the farmer losing not only the crop but all the labor of planting and caring for it, when by the use of proper rotations a paying crop could have been grown. Even the wilt-resistant varieties bred by the Department of Agriculture are not entirely resistant to root-knot and should not be planted on land infested by nematodes until such fields have been rotated to reduce the number of these eelworms. In almost every case where wilt-resistant cotton sent out by the Bureau of Plant Industry was reported to have failed, the reason was found to be the presence of root-knot.

CONTROL MEASURES.

LATE PLANTING GIVES NO RELIEF.

Carefully conducted experiments have shown that late-planted cotton is as severely attacked by wilt as that put in at the usual time. Furthermore, it is a commonly accepted fact that late-planted crops seldom produce as large a yield as those planted early. In boll-weevil territory cotton must be planted early to get ahead of the weevil.

FERTILIZERS AND FUNGICIDES INEFFECTIVE.

Cotton wilt can not be controlled by the use of fertilizers. Neither kainit, acid phosphate, salt, lime, potash, nitrate of soda, or any other fertilizer used alone or in combination has given any relief. In some cases of slight infestation the use of stable manure has been of benefit, and its use in the breeding of wilt-resistant varieties has been found of assistance.

The use of soil fungicides is too expensive to be worthy of consideration. Moreover, large quantities of numerous fungicides have been used on wilt-infected land without reducing the amount of disease.

FIG. 8.—A field of Upland cotton in South Carolina destroyed by wilt.

ROTATION OF CROPS IMPORTANT.

The fact that the wilt fungus can live for a long time as a saprophyte on the decaying organic matter in the soil renders it well-nigh impossible to starve out the disease by crop rotation. Short rotations are of little benefit. While rotations of seven to ten years have reduced the wilt somewhat, no case is known where it has been wholly eradicated. On the other hand, root-knot can be controlled by rotation. Because of the almost universal occurrence of root-knot with wilt and because of the fact that nematodes increase the severity of wilt, rotation of crops, combined with the use of resistant varieties, becomes of vital importance in the control of wilt.

WILT CONTROLLED BY GROWING RESISTANT VARIETIES.

Wilt when occurring alone can be successfully controlled by the use of wilt-resistant varieties of cotton (figs. 8 and 9). When root-knot occurs with wilt, crop rotation must be combined with the planting of resistant varieties. Thousands of acres of these varieties have been profitably grown on wilt-infected land every season for the past six or eight years. Their use on diseased land has long since passed the experimental stage and each season sees the extension of their planting to new territory.

IMPORTANT FACTS ABOUT ROOT-KNOT.

ROOT-KNOT CAUSED BY EELWORMS.

Root-knot of cotton and other crops is caused by minute eelworms, or nematodes, which bore into the roots and live there. The irritation of their presence results in the formation of irregular swellings, or galls, varying in size from tiny enlargements on the small roots to knots an inch or more in diameter on the large ones. The male

FIG. 9.—Dillon wilt-resistant cotton grown two years later on the badly infected field shown figinure 8.

worms are too small to be seen with the naked eye (fig. 10), but the females (fig. 11) when full of eggs assume a spherical shape and may often be distinguished in freshly broken roots as glistening pearly bodies half the size of a small pinhead. Each female lays several hundred eggs, and thus the worms are propagated.

HOW ROOT-KNOT IS SPREAD.

Root-knot may be carried from one field to another by any agency which will transfer some of the nematodes or their eggs, in exactly the same manner that wilt is disseminated. Drainage water is perhaps one of the most important means of spreading root-knot. In addition, a common agency for the introduction of the nematode into new territory is nursery stock. Seedling pecans, peaches, figs, mulberries, or pomegranates, and young asparagus, cabbage, eggplant, strawberry, tobacco, and tomato plants purchased from infested sections may carry the worms in their roots or in the soil adhering to them. Several cases have come to the notice of the writer which have been unquestionably traced to nursery-stock importations. In the West, where the nematode occurs quite commonly on the potato, the worms are carried in the tubers.

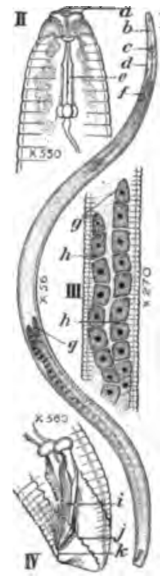

FIG. 10.—The adult male of *Heterodera radicicola*, or nematode gallworm: *I*, Worm in profile view; *II*, head of the same, more highly magnified; *III*, middle region of the worm, showing blind ends of the sexual organs; *IV*, posterior extremity. (After N. A. Cobb.)

SANDY SOILS MOST SUBJECT TO ROOT-KNOT.

Root-knot is essentially a disease of light soils. Although the disease may occur on heavier soils than wilt, yet it is not as a rule serious on soils containing a large proportion of clay. In general, the lighter the soil the more severe the root-knot injury. The places of greatest damage are usually light sandy spots or ridges in infected fields. In gardens which have been highly fertilized with stable manure root-knot is often very severe.

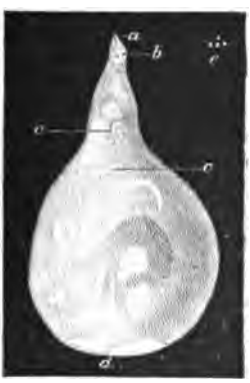

FIG. 11.—Female of the nematode gallworm (*Heterodera radicicola*), magnified 85 diameters: *a*, Mouth; *b*, spherical sucking bulb; *c*, *c*, ovaries, as seen through the body wall; *d*, anus; *e*, small white spots showing approximately the natural size of these worms. They are usually white. It is generally not difficult to isolate them in water by breaking open the galls containing them. (After N. A. Cobb.)

ROOT-KNOT ATTACKS MANY FARM CROPS.

Unlike wilt, root-knot attacks a very large number of plants, many of which are important farm crops. Those subject to root-knot injury may be divided into two groups, according to their degree of susceptibility. The crops most severely attacked by root-knot are as follows:

Bean, soy.
Beet.
Cantaloupe.
Carrot.
Celery.
Clover, bur.
Clover, crimson.
Cowpea (all varieties except Iron and Brabham and other Iron hybrids).
Cucumber.
Eggplant.
Fig.
Lettuce.
Okra.
Peach.
Pecan.
Pomegranate
Potato.
Salsify.
Squash.
Tobacco.
Tomato.
Watermelon.

The manner in which the roots of the cantaloupe and Black cowpea are covered with swellings, or galls, by the disease is shown in figures 12 and 13.

Plants less severely injured by root-knot are the following:

Alfalfa.	Collard.	Radish.
Asparagus.	Cotton.	Spinach.
Bean, Lima.	Mulberry.	Strawberry.
Bean, snap.	Onion.	Sugar cane.
Cabbage.	Pea, garden.	Vetch, common.
Clover, sweet.	Potato, sweet.	Vetch, hairy.

A few common weeds are subject to nematode injury and should therefore be eradicated where the attempt is being made to reduce root-knot in fields. The most severely injured are the balloon vine, the maypop or passion flower, and the papaya or melon pawpaw. Weeds less severely affected by root-knot are mayweed, purslane, and sweet fennel.

FIG. 12.—Root-knot on cantaloupe.

SOME FARM CROPS RESISTANT TO ROOT-KNOT.

Fortunately, a few farm crops are largely or entirely immune to root-knot. By employing these in suitable rotations, nematodes may be starved out on infested fields, so that susceptible crops can be grown until the worms increase sufficiently to cause damage, when another rotation is necessary.

The following crops are largely or entirely immune to root-knot:

Barley.	Cowpea, Iron hybrids.	Oats, winter.
Bean, velvet.	Grass, Bermuda.	Peanut.
Beggarweed, Florida.	Grass, crab.	Rye.
Chufas.	Grasses (nearly all).	Sorghum.
Corn.	Kafir.	Wheat.
Cowpea, Brabham.	Millets (nearly all).	
Cowpea, Iron.	Milo.	

ROOT-KNOT INCREASED BY MOST VARIETIES OF COWPEAS.

Such varieties of cowpeas as the Whippoorwill, Clay, Black, Unknown, Red Ripper, New Era, and others are so susceptible to root-knot that not only are they seriously injured, but the growing of them on nematode-infested fields greatly increases the number of worms in the soil, and consequently the damage to subsequent cotton or other susceptible crops. It is a common complaint of farmers in wilt sections that the wilt is noticeably more severe after a crop of cowpeas of a variety which is susceptible to root-knot. This is due to the fact that the nematodes make points of entrance for the wilt fungus, which then kills or further injures the plants. There are a few varieties of cowpeas which are highly resistant to nematodes, including the Iron and the Brabham and other Iron hybrids. These should be the only cowpeas planted on land infested with root-knot.

CONTROL MEASURES.

ROOT-KNOT CONTROLLED BY CROP ROTATION.

The rotation and diversification of crops are of fundamental importance to southern agriculture everywhere and become absolutely necessary where the root-knot nematode is present.

FIG. 13.—Root-knot on Black cowpea.

It has been repeatedly demonstrated by many farmers that root-knot can be controlled by the use of proper crop rotations. The principles on which such rotations are based are (1) the use of crops immune to nematode attacks until the nematodes are sufficiently reduced so that susceptible crops may be profitably grown and (2) the eradication of all weeds subject to root-knot. The use of crops that will return a profit and the building up of the fertility of the soil are also important considerations. Every farmer must work out for himself the particular rotations suited to his farm and his type of farming.

If land is very badly infested with nematodes as well as wilt, a 2-year or 3-year rotation with immune crops is recommended before susceptible crops, including cotton, are grown, and they should not be grown for more than one or two years thereafter before the rotation with immune crops should be repeated. When the infestation is less severe, a 1-year or 2-year rotation will do much to put the land in condition to grow the crops desired.

In planning rotations for land infested with root-knot, susceptible crops, such as tobacco, sweet potatoes, cotton, cantaloupes, okra, and tomatoes, should never follow one another. The damage increases each year so long as susceptible crops are planted. If the first crop should escape serious injury, the nematodes will increase in the soil to such an extent that the second crop will be almost sure to show a decided loss. Immune crops should always be alternated with susceptible ones and the nematode injury thereby reduced to a minimum.

With regard to winter legumes, such as crimson clover, bur clover, Japan clover, and the vetches, the use of which is rapidly increasing throughout the South, sufficient observations have not yet been made to warrant any general statement. These plants are listed as moderately to severely attacked by root-knot, but the nematodes are not very active during the period between October 15 and April 15, when these crops are usually grown, and they may therefore escape serious injury.

BEST ROTATIONS TO USE.

While no recommendations can be given that will apply to all situations and soil types, a typical rotation that can be modified to fit any condition is suggested. For land infested with both wilt and root-knot the following treatment has been successfully used by many farmers: Beginning in the fall, sow winter oats if they can be gotten in early enough to make a fairly good growth before it is necessary to plow the land for the next crop. Plow the oats under for green manure and plant corn with Iron or Brabham cowpeas between the rows, putting in the corn at the usual time, about March 15 to 20 for middle Georgia and South Carolina. In the fall sow a winter grain; this can be cut for hay or allowed to ripen. Cowpeas, either the Iron or Brabham variety, may then be broadcasted or, better, planted in 2-foot drills, where they can be cultivated once or twice. The cowpeas may be saved for seed or cut for hay and followed by another crop of winter grain. This should be plowed under in the spring in time to plant a wilt-resistant variety of cotton the third year. Wheat, rye, or barley may be substituted for oats as a winter-grain crop, and velvet beans for the Iron or Brabham cowpeas in the more southern districts. Any of the other immune crops included in the list on page 10 may be used in the rotation.

Considerable reduction in the nematode injury will follow the use of a 1-year rotation composed of two winter-grain crops with a crop of velvet beans or resistant cowpeas grown the intervening summer. In one case in Georgia, the growing of a single crop of Iron cowpeas on wilt and nematode infested land, where 75 per cent of the previous cotton crop was killed, resulted in a reduction of the loss in the cotton crop the succeeding year to less than 10 per cent, as against a loss of 90 per cent on adjoining land planted the previous year in cotton instead of Iron cowpeas. When the injury is as severe as this, however, it is usually more profitable to practice a 2-year or 3-year rotation.

WILT-RESISTANT VARIETIES DEVELOPED BY BREEDING.

The commercial varieties of cotton differ considerably in their susceptibility to wilt, but none of them are sufficiently resistant to be grown profitably on wilt-infected land. As the result of many tests it has been found that the large-bolled cottons, such as the Russell, Cleveland, Truitt, and Rogers, are in general more subject to wilt than other groups. Some of the smaller bolled varieties have shown considerable resistance and have been used as a basis for the breeding of resistant strains.

The experiments of the Bureau of Plant Industry, which have now been carried on for 15 consecutive years, have shown that the only practicable solution of the wilt problem is through the use of wilt-resistant strains developed by special breeding. Such cottons have been produced and grown successfully for the past eight or more years on thousands of acres of wilt-infected land in a large number of localities, until no doubt remains as to the possibility and practicability of controlling the disease in this way. During this period these varieties have been further improved by selection for greater resistance, larger yield, longer lint, higher percentage of lint, and other desirable qualities.

The development of wilt-resistant strains requires breeding for several years by the careful methods described later in this bulletin. Mass selections from apparently resistant strains of existing commercial varieties will not suffice. The selection of apparently resistant plants from the varieties usually grown may occasionally lead to the development of a resistant variety, but will generally result in disappointment. Only by the selection of resistant plants from an inherently resistant strain, by the subsequent testing of these on wilt-infected land, and by the continuation of individual selections and progeny-row tests can a resistant variety be developed.

DILLON.

The first wilt-resistant Upland cotton produced was the Dillon, a limbless cluster variety derived from the old Jackson Limbless. It is very productive on land to which it is adapted. Crops of a bale or more per acre have been grown where other varieties were a failure. The yield of lint is 37 to 38 per cent. This cotton has been grown quite widely since its introduction in 1904 and is still the most resistant to wilt and root-knot of any of the varieties thus far developed. The fact that it is a cluster cotton and rather hard to pick has prevented its adoption by many farmers.

DIXIE.

The second wilt-resistant variety developed by the Department of Agriculture was the Dixie. This has the branched pyramidal habit of growth characteristic of the Peterkin group of varieties and on this as well as other accounts has gained much wider popularity than the Dillon. The Dixie (fig. 14) had its origin in a selection made at Troy, Ala., of a plant presumably the result of an accidental cross between two of the numerous Upland varieties planted there in 1902. It has been carefully bred by the plant-to-row method until well fixed and has been considerably improved in earliness, size of boll, and percentage of lint.

FIG. 14.—Typical plant of Dixie wilt-resistant cotton.

The Dixie variety is now being grown very extensively throughout the wilt districts of Alabama, Georgia, and South Carolina and is very largely displacing the Dillon.

A technical description of the Dixie variety follows:

Plant vigorous, wilt resistant, of medium height, pyramidal, nearly of the Peterkin type, usually with two or more large basal branches, and with long, slender, slightly drooping fruiting limbs; leaves of medium size; bolls of medium size, about 75 being required for a pound of seed cotton, easy to pick; seed small, weight of 100 seeds 10 grams, variable in color, but typically covered with short greenish brown fuzz; lint about seven-eighths of an inch, percentage of lint to seed 34 to 35.

MODELLA.

A third promising wilt-resistant variety, the Modella, also of the Peterkin type, has been bred by Mr. A. C. Lewis, of the Georgia State Board of Entomology, and is being introduced in Georgia.

HYBRID RESISTANT STRAINS.

When the boll weevils began their eastward advance toward the badly wilt-infected cotton areas of Alabama and Georgia, a new problem was presented, the production of a variety of cotton that would be resistant to wilt and sufficiently early to be grown in the presence of the weevil. It was also desired to produce a cotton having larger bolls, longer lint, and a higher percentage of lint than either the Dixie or the Dillon variety. The indications are that both of these varieties, though medium early, are too late to be successfully grown where the boll weevil is present. Accordingly, in 1908, 1909, and 1911 a large number of hybrids were made between the Dillon and Dixie as wilt-resistant parents and several of the better large-bolled early varieties, some of which were being successfully grown in areas infested with the boll weevil, namely, the Triumph, Cook, Pride of Georgia, Columbia, Coker, Webber, Foster, and Trook.

The first of the hybrids have now been grown four years on wilt-infected land. Several promising types have been selected, which are very highly resistant to wilt, uniform, earlier than the Dillon, and possess to a greater or less degree the other characters desired of larger bolls, longer lint, and higher percentage of lint. There remains now the important work of testing these hybrids on wilt-infected land in the presence of the boll weevil, to determine which ones are best adapted to withstand the attacks of these two most serious enemies of the cotton industry. As soon as the tests are completed, the best strains will be propagated as rapidly as possible and their seed distributed.

OTHER RESISTANT VARIETIES.

Among the several so-called resistant varieties that have been developed by individual farmers, two are worthy of mention. The variety known as "Sam Wood" was developed by Judge Samuel Wood, of Abbeville, Ala., and has been grown to a considerable extent in Henry and adjoining counties of southeastern Alabama. The variety is tall, approaching the semicluster type, quite wilt resistant, productive, and gives 38 to 40 per cent of lint. Its principal faults are small bolls and short lint, great lack of uniformity, and late maturing habit. It is probably too late for successful culture in the presence of the boll weevil.

Another variety has been developed in the same section by Mr. W. F. Covington, of Headland, Ala., and is known commercially as the Covington Toole Wilt-Resistant cotton. This is a selection from the Improved Toole. It possesses the earliness and productiveness of the Toole, together with its high percentage of lint, is very uniform, and fairly resistant to wilt. For those who do not object to small bolls, short lint, and lack of storm resistance, this variety will prove superior to other commercial varieties for wilt-infected land, especially in southeastern Alabama, to which section it seems best adapted.

RESISTANCE TO WILT MAINTAINED BY CAREFUL BREEDING.

Several years' experience with wilt-resistant varieties has demonstrated the fact that resistance to wilt can be maintained only by careful attention to breeding. Special care is needed to prevent the deterioration of resistant varieties through crossing with nonresistant cotton in near-by fields, through the lack of selection, and through the mixing of seed at the public gins. A careful man can maintain the resistance of his cotton indefinitely, but when neglected it loses this quality in three or four years and must be replaced by fresh seed. Consequently, there is likely to be a permanent annual demand for several thousand bushels of carefully bred wilt-resistant seed in nearly every infected county. It is important that this should be grown in the home county, as locally grown seed gives better results than seed brought from a distance. Because of these facts an excellent opportunity exists for progressive men in every wilt-infected county to engage with profit in the growing of seed of wilt-resistant varieties of cotton. The method found most successful requires care, accuracy, and instruction at the start.

PRINCIPLES OF BREEDING.

The careful farmer has heretofore attempted to maintain the quality of his cotton by planting his seed patch at a distance from other cotton to avoid crossing, by pulling out undesirable plants, by mass selection of the best plants in the field, and by care to avoid the mixing of the seed with that of other cotton at the gin. These are all important, but one additional step is necessary for the best results in breeding for wilt resistance, viz, the adoption of the plant-to-row method of selecting and testing plants. The increased value of the plant-to-row method of breeding, which is necessary to maintain wilt resistance, is based on the principle that individual plants differ not only in their visible characters but, what is more important, in their inherent power to transmit these characters to their progeny. Two plants growing side by side may be identical so far as the eye can see, both in external characters and apparent resistance to wilt. The resistance of one plant may be due to an inherent quality, which will be passed on through the seed to the offspring, while the apparent resistance of the other may be caused by lack of wilt infection. By planting the seed of these two plants in progeny rows on wilt-infected land it is possible to pick out and save the resistant row and discard the other. (Fig. 15.) If such plants are picked together, both the good and bad qualities are perpetuated and progress is greatly hindered. The same principles apply to other characters. They are extremely important for general cotton breeding, but in breeding for wilt resistance they are absolutely essential.

BREEDING METHODS.

For the assistance and guidance of farmers who desire to take up the growing of wilt-resistant cotton seed, either for their own use or for sale, the methods worked out by the Bureau of Plant Industry as the result of 15 years' experience will be described.

Briefly, the plant-to-row method of breeding is as follows: Select the most resistant plants to be found, pick and gin them separately, plant a row from each on wilt-infected land, discard the nonresistant and inferior rows, and continue to select and breed from the best rows and plants only. The breeder must formulate a type of plant toward which to select and keep this always in mind.

FIG. 15.—Progeny rows in a breeding plat of Dillon cotton, each row from a single plant. The center row proved nonresistant. The parent plant was healthy, thus showing the necessity of progeny-row tests in the selection of resistant strains.

SELECT WILT-INFECTED LAND.

All breeding work for resistance to wilt must be done on wilt-infected land, so that nonresistant plants will be eliminated as rapidly as they appear and only resistant ones propagated. Land uniformly infected with wilt should be selected, as free as possible from root-knot, separated from other cotton to avoid cross-pollination, and near enough to the house to be convenient for selection work at odd times. The plat may be located in a cornfield or in a field of the same variety of cotton. It should be rectangular in shape, with all the rows the same length, and prepared and fertilized as for other cotton. The rows should be laid off 4 to 4½ feet apart and the hills 2 to 2½ feet, to allow room for the normal development of plants.

PLANT SELECTIONS IN PROGENY ROWS.

Plant 100 hills of each selection, four or five seeds to the hill, and save the remainder for replanting. Checkrow to get the hills evenly spaced, or stretch beside the row a cord with the distances indicated. Make a shallow trench with a small bull-tongue or make a depression with the heel. Drop the seed in this and cover it lightly with the foot. Drive a stout stake at the end of each row and write the selection number on it with a hard lead pencil. Make a diagram of the plat, recording the number and location of each row, as stakes are sometimes broken in cultivation.

THIN TO ONE PLANT TO THE HILL AND PULL OUT DISEASED PLANTS.

After replanting and when the cotton is all up, thin to one plant to the hill and record the number of plants left in each row. Under no circumstances replant with any other cotton. Go over the plat occasionally and pull out all diseased plants. In September, just before selections are to be made, count the healthy plants in each row. These counts compared with the stand counts will give the percentage of wilt resistance.

SELECT THE BEST ROWS AND PLANTS.

Discard rows showing much wilt. Carefully compare the most resistant rows with regard to earliness, productiveness, uniformity, type, size of bolls, and length and quantity of lint, and save four to eight of the best rows. In the selection of rows as well as plants, wilt resistance is the first and most important consideration. Continuous selection toward a certain ideal type is also essential. Pick separately several of the best plants from each selected row, giving each its proper row number with the plant number added, thus, 18–1, 18–2, 18–3, and so on. Use tags for labeling plants and sacks. Selected plants should be free from anthracnose and other diseases.

MAKE CAREFUL NOTES.

Notebooks must be provided to record the data regarding the rows and plants. Make notes on the selected rows covering the points considered in the selection. Take notes on each selected plant covering the following points: Earliness, shape, height, and productiveness of plant, length of joints, shape and size of bolls, size and color of seed, and length, strength, and percentage of lint. A special 4 by 6 inch note blank with spaces provided for these notes in detail has been devised and used by the Department of Agriculture in all of this breeding work. By the use of these blanks the time required to make the necessary notes has been greatly reduced. Neatness and legibility are important, and to this end a pen or hard lead pencil should be used, as notes taken with a soft pencil soon become rubbed and blurred. Notes should be entered directly in the notebook and not copied from memoranda.

GIN THE SEPARATELY SELECTED ROWS AND PLANTS.

The ginning of the individual selections and progeny rows should be left until winter, when the rush of fall work is over. A small hand gin is most convenient for ginning individual plants. Three types of hand gins are on the market: (1) A small saw gin, very similar in appearance to the ordinary commercial saw gin, but having only 10 saws and furnished with a handle by means of which it is operated; (2) a small-sized roller gin of the type generally used to gin Sea Island cotton and also operated by a handle; and (3) a gin somewhat similar to the roller gin, but having a series of fingers instead of beaters to break the lint from the seed. The price of these gins ranges from $50 to $75. It is often possible for several farmers to club together to bear the expense of such an outfit. A single large saw gin can be used for row plats. In ginning different individual plants or progeny rows, great care should be taken to see that the gin is thoroughly cleaned out after each operation, so that not a single seed will be left to mix with the succeeding lots.

DETERMINE THE LENGTH AND PERCENTAGE OF LINT OF EACH PLANT AND ROW.

Weigh the seed cotton from each plant or row; gin and weigh the seed. Compute the percentage of lint by dividing the weight of lint by the weight of seed cotton. In the final selection of plants to be grown, give preference to those with high lint percentage. Determine the length by combing out the lint on a few seeds and measuring with a rule. Discard selections having lint less than three-fourths to seven-eighths of an inch long.

PLANT THE BEST SELECTIONS AND ROWS.

When all the plants have been compared, pick out 25 to 50 of the selections made which have the longest and best percentage of lint and which conform most nearly in other characters to the type adopted. Plant these the next season in progeny rows, as already described. Save the best progeny rows and selections from them, as before.

Plant in increase plats the seed of the two or three best rows saved, dropping them by hand to make them go as far as possible. Save a few seeds for replanting and under no circumstances use any other cotton seed for this purpose. The increase plats may well be planted immediately surrounding the progeny block. Thin to one plant in a place. Go over the plats several times row by row and pull out all wilted and off-type plants, to prevent their crossing with good plants. If very much wilt develops in any plat, discard it. Pick the increase plats by themselves, carefully sack and label the cotton, and put it away until the rush of the ginning season is past.

GIN WITH GREAT CARE.

To avoid every possibility of mixing with other seed, use a single gin, remove every seed from the roll, and do not pass the cotton through the usual suction chute, but feed by hand and catch the seed on a burlap sheet on the floor. Weigh the seed cotton and the seed from each plat and determine the lint percentage. Store the seed where there will be no danger of its being mixed with other seed.

PLANT THE SEED FIELD FROM THE BEST INCREASE PLAT.

Use the seed from the increase plat showing the greatest wilt resistance, highest productiveness and percentage of lint, and other characters conforming most nearly to the adopted type for planting a seed field. Give this field the same care as the increase plats.

Beginning with the third year and each year thereafter, the farmer will have 25 to 50 progeny rows immediately surrounded by two to four increase plats and a large seed field from which seed can be sold or used for planting larger areas.

Careful personal supervision of the details of this work is essential for the maintenance of the best grade of seed.

THE DEPARTMENT OF AGRICULTURE AND THE EXPERIMENT STATIONS COOPERATE WITH FARMERS.

The demand for wilt-resistant cotton seed became so great in 1910 that arrangements were made with a dozen farmers in South Carolina and Georgia to grow seed for sale under the supervision of the Department of Agriculture. This was a distinct success, but the demand for seed was greater than the supply. In 1911 the work was still further enlarged by a cooperative arrangement between the Bureau of Plant Industry and the experiment station in South Carolina and the State Board of Entomology in Georgia.

PURPOSE OF THE WORK.

The purpose of this cooperative work is twofold: (1) To provide a definite and active means of carrying directly to the farmer facts regarding the nature of the wilt and root-knot of cotton and other crops and the best methods of controlling them and (2) to secure the assistance of progressive farmers in all wilt infected sections in the production of an adequate supply of resistant cotton and cowpea seed to meet the local demand, to maintain its quality, and to produce still better strains.

HOW THE WORK IS DONE.

In the dissemination of information about wilt and root-knot every available agency is utilized. A field pathologist, representing the Department of Agriculture and the State agency, visits all sections of the State where these diseases occur and gives lectures on them at farmers' institutes, at county and State fairs, at meetings of the agents of the Farmers' Cooperative Demonstration Work, and at other gatherings of farmers. The demonstration agents are very important means of getting information and advice to the farmer at first hand. It is therefore essential that they have a full and accurate understanding of all the details, so that correct advice may be given. From time to time the local newspapers are supplied with articles on these same subjects. Bulletins are also published by the Department of Agriculture and by the State agricultural experiment stations.

FARMERS BECOME COOPERATIVE BREEDERS.

Under the supervision of the field pathologists about 50 farmers in the States of South Carolina and Georgia are now growing wilt-resistant cotton seed for sale. These cooperative breeders agree to secure proper seed, to follow the breeding methods outlined by the field pathologist, to exercise necessary care to maintain the purity of their seed, and to offer it for sale at a reasonable price, not to exceed an amount previously agreed upon. They also agree not to sell seed not grown by them unless so stated.

The field pathologist, as a representative of the State and of the Department of Agriculture, provides these cooperative breeders with small quantities of select planting seed in the beginning or refers them to other breeders from whom they can purchase such seed at a reasonable price. He visits the breeders several times during the season to advise with them regarding the work and to show them all the details, from the planting through the roguing, selection, note taking, and ginning. He will also inspect the seed fields and give the breeders seed certificates.

SEED CERTIFICATES GIVEN.

In the early stages of the work it was not found advisable to start the system of seed certification, as was originally planned, but such a system will eventually be put into practice. Two grades of seed will be recognized—"registered seed" and "improved seed." By "registered seed" is meant seed grown by the individual-selection and progeny-row methods described in this bulletin, which is found on inspection to be resistant and of the highest grade and purity. As "improved seed" will be designated all other seed where the standard of the variety in wilt resistance, productiveness, and purity is being maintained, but where the plant-to-row method is not being followed in all of its details. These certificates will be given only after thorough inspection of the growing crop by the field pathologist and after an official test of the seed in comparison with standard resistant strains.

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